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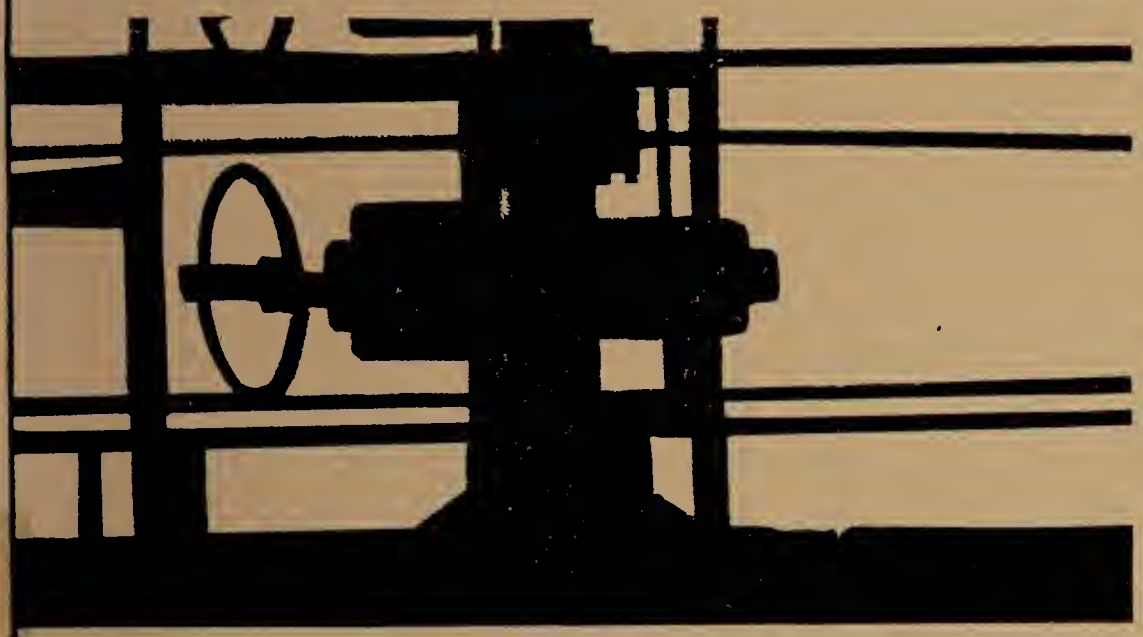
RILEY RIDGE
NATURAL GAS PROJECT
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
AND DECISION RECORD

EXXON LABARGE PROJECT

WASTE WATER DISPOSAL

JUNE 1985

DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT
DEPARTMENT OF AGRICULTURE
FOREST SERVICE



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BUREAU OF LAND MANAGEMENT
ROCK SPRINGS DISTRICT OFFICE
P.O. Box 1869
Rock Springs, Wyoming 82902-1869
(307) 382-5350

IN REPLY REFER TO:

1792 (FK21)
(420)

JUN 25 1985

Dear Reader:

As stated in the Riley Ridge Natural Gas Project Record of Decision (ROD), January 1984 (Page 14), the effects of deep well injection (disposal) of waste water was not fully analyzed due to lack of information on the applicants' injection engineering plans and specific water resource data. Therefore, the ROD specified that prior to allowing this activity, further analysis of impacts would be required. In addition, the Wyoming Oil and Gas Commission, the Wyoming Department of Environmental Quality, and BLM must review and approve the applicants' disposal plans.

This Environmental Assessment (EA) and Decision Record on the Exxon proposed waste water disposal are provided for your information. Any comments you may have are certainly welcomed. Comments received will be given consideration during the processing and implementation of each application for permit to drill (APD), notice of sundry application, and rights-of-way applications as described in Attachment B and D of the Riley Ridge EIS ROD. This EA and Decision Record will serve as the site-specific Environmental Reference Report and Decision Record referred to in Attachment D of the Riley Ridge ROD.

Comments should be directed to Donald H. Sweep, District Manager, Bureau of Land Management, P.O. Box 1869, Rock Springs, Wyoming 82902-1869, or Reid Jackson, Forest Supervisor, Bridger-Teton National Forest, P.O. Box 1888, Jackson, Wyoming 83001.

Sincerely yours,

Gene C. Herrin

Associate District Manager

EA No. WY-049-EA85-51

EXXON LABARGE PROJECT
WASTE WATER DISPOSAL WELLS
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT (EA)
DECISION RECORD

PROPOSED ACTION

Exxon, as part of its LaBarge Project, proposes to construct, drill, operate and maintain three waste water disposal wells. These wells are needed by Exxon to dispose of waste water produced from the Madison Formation (approximately 16,000 feet) and condensed from gas dehydration. The waste water would be injected into the Nugget Formation (approximately 12,000 feet). Required associated facilities are access roads (4900 feet), pipeline (10,800 feet), powerline (10,800 feet) and three well pads (4 acres each). The three wells would be located in section 35, Township 28 North, Range 114 West, and Section 2, Township 27 North, Range 114 West.

The proposal to dispose of waste water by deep well injection was addressed in the Riley Ridge Natural Gas Project EIS, however, the impacts were not analyzed because of the lack of information. Therefore the attached Supplemental EA was prepared as directed by the Riley Ridge Natural Gas Project Record of Decision (ROD).

It was determined, through the Riley Ridge Natural Gas Project EIS and ROD, that the overall Exxon LaBarge Project proposal does conform with applicable BLM and FS land use plans.

ALTERNATIVES CONSIDERED

Although no unresolved conflicts were identified in the Proposed Action, four alternative methods of Waste Water disposal were considered. However, as the result of an overview of the potential resource changes/conflicts caused by the associated components of each alternative (Table I-4), all four alternatives were dropped from further consideration.

The overview provides comparative information on the Proposed Action and each alternative such that the environmental advantage, technical feasibility and/or reasonableness of each could be determined. On the basis of this, a decision whether to complete a more detailed assessment of impacts was made. The alternatives neither provide substantial environmental advantage nor reasonable methods of disposal under the given circumstances. The alternatives are as follows:

No Action Alternative

No action would constitute BLM denial of the disposal well APD's and essentially the injection well method of waste water disposal. This would mean that other methods of waste water disposal would have to be considered. Four possible alternatives are (1) lined pit, (2) aerial evaporation; (3) purify and release, and (4) surface release. The following discusses these in more detail.

Lined Pit Alternative

This alternative, in accordance with the Bureau of Land Managements "Notice To Lessees and Operators" for disposal of produce water (NTL-2B), is one of the methods that can be used for disposal of produced and process waters. However, to handle the volume of water of concern (approximately 1 acre foot per day or 365 acre feet per year; using a 30-inch evaporation rate; and in consideration of a 50 year - 24 hour event) a 100 to 200 acre pit (depending on depth) would be required.

This alternative has been eliminated from further consideration because the water to be disposed of is water unfit for domestic, livestock, wildlife, irrigation or other use. The water would be essentially fresh with hydrogen sulfide dissolved in solution. Small amounts of production additives (e.g., Triethylene glycol, corrosion inhibitor) will be contained in the waste water.

The pit would attract waterfowl, waterbirds, and other wildlife species. An unquantified number of wildlife species would be killed unless special measures were taken to discourage wildlife entry.

The rate of evaporation may not be sufficient to maintain evaporation losses, particularly during the winter period. This could result in an overflow.

This alternative showed no environmental advantage over the proposed method of waste water disposal.

Aerial Evaporation Alternative

Aerial evaporation by spraying the waste water into the air would increase the evaporative rate. However, it would not eliminate the need for a large lined pit, or the potential loss of wildlife, among other impacts. Because this alternative showed no environmental advantage over the proposed method, it was eliminated from further consideration.

Purify And Release Alternative

Under this alternative waste water would be processed to a purity that would meet effluent quality levels of the Wyoming Water Quality Regulations and Standards. This assumes a water quality level equal to or greater than the natural quality of Black Canyon Creek. The cleaned (purified) water would be released into Black Canyon Creek, Dry Piney Creek and into the Green River.

The clean-up and surface disposal of produced water is not practiced in the oil industry. The technology has not been formalized to date to desalinate and remove the toxic chemical additives from produced and condensed water. Even if the technology were available an upset could be catastrophic. The magnitude of surface water pollution that could occur would be unacceptable. For these reasons the Purify and Release Alternative was considered an impractical and unreasonable alternative to subsurface injection of waste water. It was therefore dropped from futher consideration.

Surface Disposal Alternative

This alternative would discharge waste water out onto the ground and allow it to perculate into the ground. This alternative was eliminated from further consideration because the water quality would violate State of Wyoming Water Quality Regulations and Standards, as well as BLM NTL-2B Produced Water Disposal Regulations.

DECISION AND RATIONALE

Decision: It is the decision of the Rock Springs District Manager of the Bureau of Land Management, in consultation with the Bridger-Teton Forest Supervisor of the U.S Forest Service, to approve the disposal of produced and condensed water by the method of injection into the subsurface, specifically injection into the Nugget Formation. Approval is contingent upon implementation of the mitigation described in the Waste Water Disposal Wells Supplemental EA and the Riley Ridge Natural Gas Project ROD.

Supporting Rationale: Based on the anaylsis of impacts to the affected resource values, the impacts of the Proposed Action would be less than or equal to the five alternatives considered. Implementation of the BLM and FS required federal mitigation measures stipulated in the Riley Ridge Natural Gas Project ROD, coupled with the Federal and State of Wyoming regulation on waste water disposal by injection into the subsurface, would effectively mitigate the impacts associated with injection. The requirement of a groundwater monitoring plan, to be implemented and maintained throughout the life of the project, would provide the means of quick detection of any groundwater or surface water contamination problems.

Mitigation: All the appropriate required federal mitigation measures contained in the Riley Ridge ROD (Attachments B and D) will be required. In addition, the mitigation measures contained in the Waste Water Disposal Wells Supplemental EA will be included as required permit conditions.

Monitoring: All the appropriate required monitoring (air quality, groundwater, fisheries and surface water, cultural compliance, roads and erosion control, revegetation and restoration) described in Section VI of the Riley Ridge ROD will be required.

CONCLUSION

Based on the analysis of the Waste Water Disposal Wells Supplemental EA, I find that this action is not expected to have a significant impact on the human environment and, therefore, conclude that no EIS is necessary. The proposed action is in conformance with applicable BLM land use plans.

APPROVAL:

Gene C. Hurrin — 6/25/85

Associate District Manager, Rock Springs District — Date

Bureau of Land Management

#55065150

ID: 38074163

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DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT WY-049-EA85-51

RILEY RIDGE NATURAL GAS PROJECT EIS

EXXON LABARGE PROJECT

WASTE WATER DISPOSAL WELLS

SUBLETTE COUNTY, WYOMING

JUNE 1985

Prepared by

BUREAU OF LAND MANAGEMENT

ROCK SPRINGS DISTRICT

In Cooperation With

BRIDGER-TETON NATIONAL FOREST

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PREFACE

In 1981, the Riley Ridge Natural Gas Project was proposed as individual projects by:

1) Northwest Pipeline Corporation and Mobil Oil Corporation
2) Exxon Company, U.S.A.
3) American Quasar Petroleum Company and Williams Exploration Company

This natural gas development project included the proposal to construct, operate, and abandon a deep gas well field in western Wyoming; gathering lines for the transportation of sour gas within the well field to dehydration facilities; dehydration facilities; trunklines for the shipment of sour gas from the well field dehydration facilities to the treatment plants; three treatment plants; sales gas pipelines; power transmission lines for supplying power to the well field and treatment plants; and facilities for handling and transporting by-products (sulfur and carbon dioxide) to markets.

In 1982 (between March and July), the applicants applied to the Bureau of Land Management (BLM) for right-of-way permits to cross federal land managed by the BLM and Forest Service (FS). The impacts of the project actions and components were analyzed in the Riley Ridge Natural Gas Project Environmental Impact Statement (EIS) prepared jointly by BLM and FS (BLM and FS, 1983). In addition to the proposed project, the Riley Ridge EIS evaluated component and treatment plant siting alternatives and a No Action alternative.

The Riley Ridge EIS, prepared in accordance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) regulations, is the environmental document covering Exxon's overall LaBarge Project proposal. It was determined through the Riley Ridge EIS and accompanying Riley Ridge Natural Gas Project Record of Decision (ROD), which was completed in January 1984, that the overall project proposal is in conformance with applicable BLM and FS land use plans. The ROD approved well field development, treatment plant locations, general trunkline locations, power transmission line locations, treatment plant access roads, gas venting conditions, and other associated development and implementation requirements for construction, operation, and abandonment.

However, as stated in the Riley Ridge Natural Gas Project ROD (Page 14), the effects of deep well injection (disposal) of waste water, which is separated from produced gas at well field dehydration facilities, was not fully analyzed due to lack of information on the applicants' injection engineering plans and specific water resource data. Therefore, the ROD specified that prior to allowing this activity, further analysis of impacts will be required. In addition, the Wyoming Oil and Gas Commission, the Wyoming Department of Environmental Quality, and BLM must review and approve the applicants' disposal plans. In association with the permitting and/or approval of the applicants' disposal plans, the collection of hydrogeologic information and the development and approval of a ground water monitoring program will be required.

This environmental assessment (EA) is being prepared as a supplement to the Riley Ridge Natural Gas Project EIS. Since only Exxon has proceeded with the implementation of their project plans, this EA is being prepared to analyze the environmental impacts of Exxon's proposed waste water injection program.

CHAPTER I

CHAPTER I
PROPOSED ACTION AND ALTERNATIVES

INTRODUCTION

As described in the Riley Ridge Natural Gas Project Draft EIS (BLM 1983; page 1-36), Exxon originally planned for a dehydration system at each well head or a system of several larger dehydration facilities located at strategic locations within the well field. The dehydration process separates water and water vapor from the produced gas so that ice and hydrates will not form causing corrosion in the pipeline distribution system. The water produced during dehydration would be piped to underground disposal wells. During the summer and autumn of 1984, Exxon, the BLM and FS determined that some changes could be made to the plans for design and operations of the well field that would reduce potential environmental impacts. Six separate dehydration facilities, with one or more located in each drilling unit (each with at least one associated waste water injection well), could be eliminated and only one dehydration facility at the southeast end of the well field (off the mountain) with three injection wells. Five manifold facilities would be constructed in the well field; 3 in Fogarty Creek Unit and 2 in Lake Ridge Unit. These manifolds would combine flow lines from individual wells, separate free water from the gas stream, and direct the flow to large diameter, reduced pressure trunklines for transportation to the dehydration facility. This change was analyzed in the Exxon LaBarge Project Well Field Changes Supplemental Environmental Assessment completed by the BLM in February, 1985. A decision record approving this change was signed March 18, 1985.

PURPOSE AND NEED

Produced water (water from the Madison Formation) and condensed water (dehydrated from gas) is water unfit for domestic, livestock, wildlife, irrigation or other general uses. Pursuant to the provisions of the "Notice to Lessee - Disposal of Produced Water" (NTL-2B), all produced water must be disposed of by (1) injection into the subsurface; (2) lined pits; or (3) by other acceptable methods. Produced water disposal is essential for Exxon to implement their overall LaBarge Project.

AUTHORIZING ACTIONS

Federal and State permits would be required by Exxon to implement their proposed waste water disposal plans. The required authorizations would insure compliance with standards and requirements that in turn would mitigate potential impacts. Appendix A provides the specific Federal and State regulations and standards pertaining to water disposal. These include the United States Department of Interior Geological Survey, Conservation Division (now Bureau of Land Management, Minerals Division) Notice to Lessees and Operators of Federal and Indian Oil and Gas Leases (NTL-2B) - Disposal of Produced Water, and Wyoming Oil and Gas Conservation Commission Rules and Regulations - Underground Disposal of Water (Rule 336) and Aquifer Exemption (Rule 407). The Wyoming Department of Environmental Quality/Water Quality Division (WDEQ/WQD) will review the permit applications in conjunction with the Oil and Gas Conservation Commission as specified in Chapter IX of the WDEQ/WQD Rules and Regulations.

Federal Permits required include permits to drill each well and rights-of-way to construct associated access roads, waste water pipelines, and powerlines.

DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

PROPOSED ACTION

Application For Permit To Drill

On April 30, 1985 Exxon submitted "Applications for Permit to Drill" (APD) for two waste water disposal wells. Three wells will be needed to provide disposal capability for Exxon's planned 39 well production capacity. The third APD would be filed in 1986 when Exxon's Phase II implementation is anticipated to be underway. The disposal program would involve the injection of waste water into the Nugget Formation. The APDs contain specific information on drilling, engineering and down-hole operations (10 point plan) and construction, operation, and reclamation of surface facilities (13 point plan). A copy of the APD for one of the disposal wells (Well No. 2-35) is included in Appendix B. The information presented therein is typical for the other two wells.

Project Components

The Proposed Action consists of the construction, operation and abandonment of the following components:

- 4900 feet of access road
- Three drill locations, approximately 4 acres each
- Drilling three waste water disposal wells - two in 1985 and one in 1986
- 10,800 feet of waste water flow lines from the dehydration plant to each well
- 10,800 feet of 13.8 kV powerline from the dehydration plant to each well head
- Reclamation of all disturbed areas not needed for operation
- Operation and Abandonment of three waste water disposal wells

Disposal Well Locations

Disposal wells are proposed to be drilled in the NE 1/4 of Section 35 (Well No. 1-35), SW1/4 of Section 35 (Well No. 2-35), of Township 28 North, Range 114 West, and SE1/4 of Section 2 (Well No. 3-2) of Township 27 North, Range 114 West, Sublette County, Wyoming (Map I-1). The proposed wells are located in the Wexpro operated Dry Piney Unit and are strictly for waste water disposal. They would not be involved in any field production. Well Nos. 1-35 and 2-35 are located on private surface. Well No. 3-2 is located on public land.

Exxon has met with or contacted all lease operators or owners and surface owners within one-half mile of the proposed disposal wells. The names and addresses of these people are provided in Appendix C-1. The locations of all lease operators or owners are provided in Appendix C-2 and surface owners on Appendix C 3.

LAKE RIDGE UNIT

GRAVEL PIT

WATER DIVERSION POINT

Y CREEK UNIT

NEW ACCESS ROAD
(APPROX. 500')

LBD/WDW UNIT #1-35

DEHY. SITE

11-DPU

LBD/WDW UNIT #2-35

BELCO 8-DPU

POINT OF NEW CONSTRUCTION

WEXPRO 28-DPU
(ABANDONED)

NEW ACCESS ROAD
(APPROX. 2600')

WATER DIVERSION POINT

N-FUEL 9-DPU

LBD/WDW UNIT #3-2

NEW ACCESS ROAD
(APPROX. 1800')

MTN-FUEL 5-DPU

EXISTING ROAD

MAP I-1

LBD/WDW UNIT #1-35
SEC. 35, T-28-N, R-114-W
SUBLETTE CO., WYO.
SCALE: 1"-2000'
4/22/85 SMW
W-B-2013

Injection Formation Description

Produced water from the Madison Formation (approximately 16,000 feet) and waste water condensed from gas dehydration would be injected into the Nugget Formation (approximately 12,000 feet).

Geologic Setting

The Dry Piney Unit (T27N-28N, R114W) is located along the eastern margin of the western Wyoming Overthrust Belt. The surface formation at the proposed disposal site is Tertiary (undivided). The oldest formations to be penetrated by the proposed disposal wells are Cambrian (overthrust) and Triassic Ankareh (subthrust).

The APD included in Appendix B, Page 3 gives the estimated depth to the tops of important geologic formations that would be involved in these injection well locations. A structural cross section of the Dry Piney Area is provided in Figure I-1.

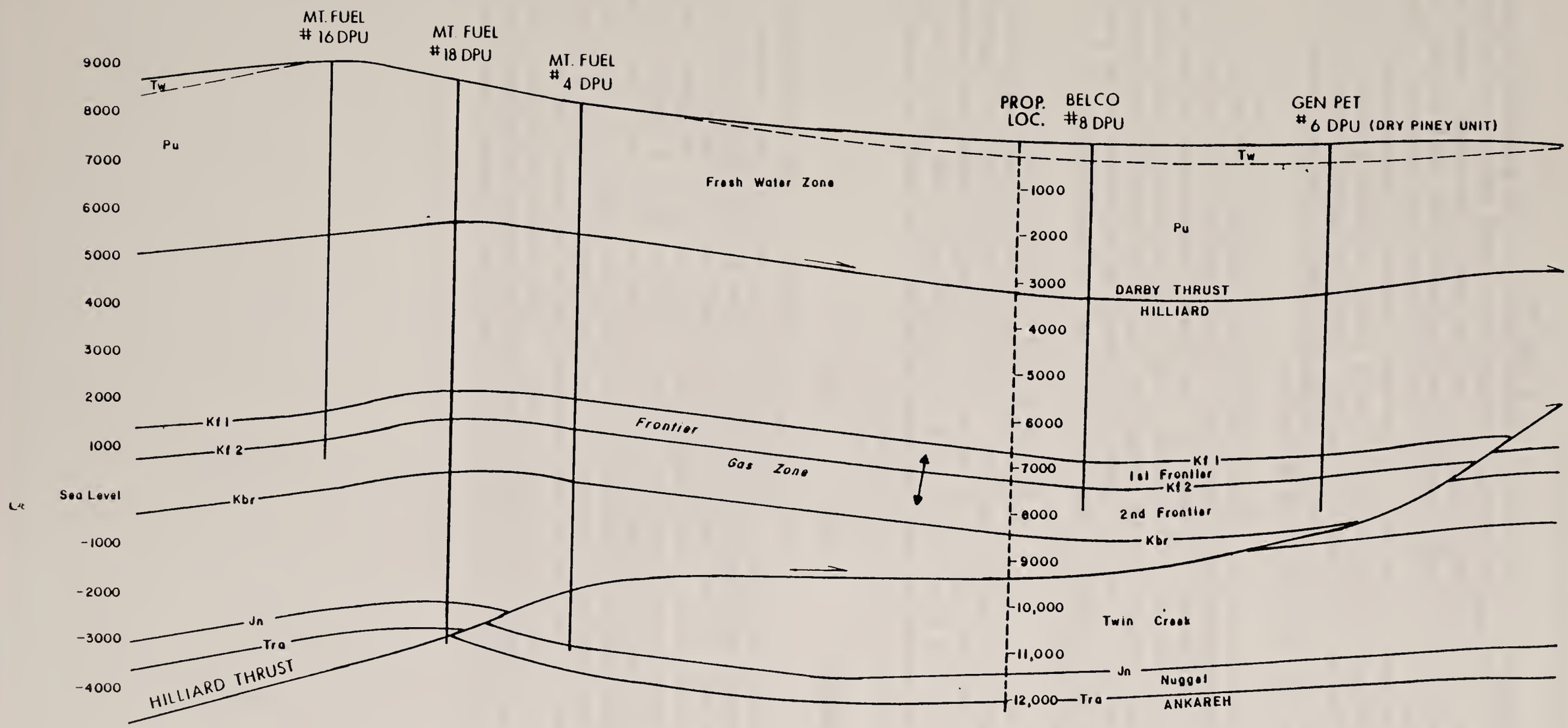
Hydrocarbon Production

Oil and gas production in the Dry Piney Unit has been established in the Frontier (7,500 feet), Bear River (9,000 feet) and Nugget (11,000 feet) Formations. Hydrocarbon accumulation in the Nugget Formation in the Unit is structurally controlled along the Dry Piney Anticline. The structure is tightly folded, double-plunging northwest-southeast trending anticline which has been faulted on the east side due to reverse faulting associated with structuring. The productive Nugget Formation along the structure has an estimated original oil water contact of -2225 feet.

The proposed disposal wells will be drilled to the Nugget Formation in a structurally low position (approximately -3000 feet sub-sea) within the unit and approximately 1000 feet structurally low to existing Nugget production. There are no existing Nugget penetrations within one and one-half mile of each proposed well; with the nearest established Nugget production being greater than 2 miles southwest. Partial fault separation of the Nugget is likely along the eastern edge of the Dry Piney anticline which would result in isolation of the Dry Piney productive interval from the proposed disposal site.

Other Injection Into Nugget

As operator of the Dry Piney Unit, Wexpro has applied for and obtained permits to inject produced water from the Nugget formation back into the Nugget at depths between 11,008 feet and 11,064 feet in the Dry Piney Unit #19 well. Dry Piney Unit #19 well was shut-in after depletion of oil and commencement of water production from the Nugget. Four of the original six Nugget oil wells in the southwest part of Dry Piney Unit continue to produce oil with high water cuts. In 1984 these four wells produced 690 barrels of oil and 11,500 barrels or water. The Dry Piney Unit #19 well is greater than two miles distance from Exxon's nearest proposed water disposal well.



1000'
SCALE
1000'

SYMBOLS: Age & Formation Names

Tw	Tertiary Wasatch
Kf 1	Cretaceous First Frontier
Kf 2	Cretaceous Second Frontier
Kbr	Cretaceous Bear River
Jn	Jurassic Nugget
Tra	Triassic Ankareh
Pu	Paleozoic Undivided (Includes Madison Through Death Canyon)

STRUCTURAL CROSS SECTION
DRY PINEY AREA
SUBLETTE COUNTY
WYOMING

FIGURE I-1

Nugget Formation (Triassic-Jurassic)

The Nugget Formation is 550 feet - 600 feet thick at the proposed disposal site. It is a quartzose sandstone, containing 90-95% quartz, 5-10% feldspar, and trace amounts of magnetic, pyrite, and pelletal glauconite. Sand grains are mostly very fine to medium grained, well rounded and well sorted. The grains are clear to pink, and locally have an iron-oxide coating. Clays are rare and, where present, consist of montmorillonite in trace amounts. Rocks of the upper Nugget Formation consist of a fairly uniform massive, cross-bedded facies (continental - eolian) composed almost entirely of sandstone and siltstone and are unconformably overlain by the Jurassic Gypsum Springs member of the Twin Creek Formation.

The upper, cross-stratified facies exhibit well developed porosity and permeability development with excellent lateral continuity. Porosity and permeability development is poorer in the lower, thin-bedded facies; although there exist intervals which do exhibit fair to good porosity development. Disposal of waste water will be attempted in all developed Nugget porosity intervals. The net potential disposal interval is estimated to be greater than 300 feet thick, with an average of 8.5 percent porosity and 1.8 millidarcy (md) permeability.

An effective bottom seal exists for the Nugget Formation because of the underlying Ankareh Formation which is composed of non-porous and impermeable shales. An effective upper seal exists for the Nugget Formation because of the lithology of the overlying Gypsum Springs member of the Twin Creek Formation. The anhydrite beds and dense dolomite beds create a non-porous and impermeable cap for the Nugget Formation.

Injection Program

An average of 2200 barrels of water per day (BWPD), or 5000 BWPD maximum, would be injected into each of the three disposal wells. The average injection pressure would be 2000 pounds per square inch (psi), or 2500 psi maximum. The base of the lowest potential fresh water in the wells is approximately 3000 feet. The disposal zone is at a depth of approximately 12000 feet. Based on an operative fracture gradient of 0.7 psi/foot for the Nugget formation and a maximum injection pressure of 2500 psi, the injected water would not initiate fractures to the overlying strata or confining zone described in the geological description of the Nugget. Table I-1 presents the assumption used in calculating the radius of injected water influx into the Nugget formation around each disposal well. The radius of disposed water influx over the 50 year life of the project is estimated to be 2015 feet or 0.38 miles. A schematic wellbore sketch showing the injected water influx is provided in Figure I-2.

TABLE I-1

Estimate of Radial Injected Water
Influx into the Nugget Formation
Around Each Disposal Well

Assumptions

- Average net pay thickness of 320'
- Average formation porosity of 8.5%
- Average immobile Nugget water saturation of 35% (injected water will fill 65% of pore space)
- Incompressible injection fluid
- Average injection rate of 2200 BBLS/day (per well)
- Estimated project life of 50 years

Solution

Volume of fluid injected = rate x time

$$= 2200 \frac{\text{BBLS}}{\text{Day}} \times 365 \frac{\text{Days}}{\text{Year}} \times 50 \text{ years}$$

$$= 40{,}150{,}000 \text{ BBLS}$$

$$\text{Area of Reservoir} = \frac{\text{Volume of Fluid Injected}}{(\text{Available Portion of Reservoir Volume}) \times (\text{Net Pay Thickness})}$$

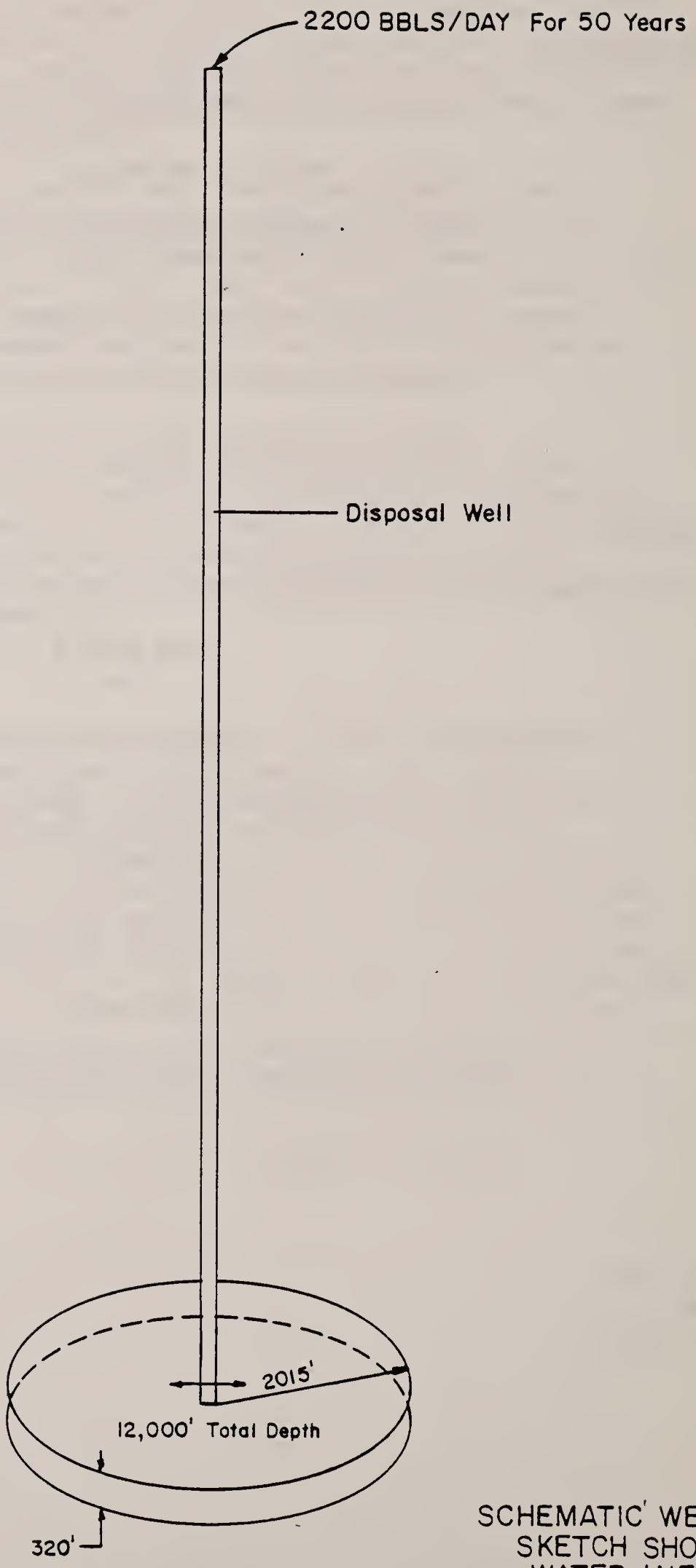
$$= \frac{40{,}150{,}000 \text{ BBLS}}{(.085)\ (1-.35)(320 \text{ ft.})\ (7758 \text{ BBLS/acre-ft})}$$

$$= 293 \text{ acres}$$

$$\text{Radius of Influx} = \left(\frac{293 \text{ acres} \times 43560 \text{ ft}^2/\text{acre}}{3.1415}\right)^{1/2}$$

Radius of Influx = 2015 ft. or 0.38 miles

WT::sf
AO9
5/10/85



SCHEMATIC WELLBORE SKETCH SHOWING WATER INFLUX

FIGURE I-2

Source: Exxon Company, USA, May 1985

Analysis of Water To Be Disposed

An analysis of the water to be injected and of the Formation water into which injection is to occur is provided in accordance with NTL-2B and Wyoming Oil and Gas Commission Rule 336. The water to be disposed will contain both water produced from the LaBarge Deep Field wells and waste water condensed from the produced gas at Exxon's LaBarge Dehydration Facility. An analysis of produced water is provided in Table I-2, but only an estimate of the composition of the dehydration water can be made at this time. When the Dehydration Site is constructed and in operation, Exxon would provide an analysis of the actual waste water. Exxon estimates that the waste water will be essentially fresh with hydrogen sulfide dissolved in solution (0.41%). In addition, small amounts of additives from the dehydration facilities (corrosion inhibitor additives, and production additives) will be contained in the waste water. A standard laboratory analysis of water from the Nugget formation is included in Table I-3.

Subsurface Facilities

The APD included in Appendix B, pages 3 thru 16 provides a detailed description of the design and engineering of the subsurface facilities including the engineering of the subsurface facilities including the casing and cementing program, blow-out prevention, testing program, safety measures and other specific description. Figure I-3 provides a cross section of the proposed disposal well design.

Twenty inch conductor casing would be set at a depth of 0 to 80 feet. This would provide stability while drilling a 12-1/4 inch diameter surface hole to the depth of 3400 feet. A 9-5/8 inch surface casing would be set to 3400 feet and would be cemented back to the surface to prevent contamination of fresh water zones. A 9-1/2 inch diameter production hole would then be drilled into the Nugget formation (12,000 feet). The production casing would be 7 inches and would be cemented back to 400 feet above the Frontier Formation, (6,000 feet). The plugged-back total depth would be approximately 11,900 feet. Once the casing and cementing program has been completed, then 3-1/2 inch tubing (3/8" high strength steel) would be installed from the surface to approximately the 10,600 foot level. There a packer (special seal) would be installed. The packer seals the space between the tubing and the casing (called the tubing-casing annulus). This annulus will be pressure tested monthly to insure that there is no leak in the tubing. After the production casing is set and cemented, the well would be perforated in the Nugget Formation.

Drilling Water Needs

The drilling operation at each well would require an average of 9 gallons per minute of water (4 to 5 acre-feet per well). Water usage may exceed 12 GPM during peak demand periods. This water would be supplied by water wells drilled by Exxon and other sources near the locations. The other sources would be from Beaver Dam Creek (Permit No. 28413) and Black Canyon Creek (Permit No. 28412), the diversion points for which are shown on Map I-1. In the event that insufficient water is produced, it would be trucked in from other permitted sources. The drilling fluid would consist of water, bentonite, gel and minimal amount of chemicals. The proposed drilling fluid would weigh approximately 9.0 to 10.0 pounds per gallon throughout most intervals.

TABLE I-2

P O BOX 1468
MONAHANS TEXAS 79756
PH 943-3234 OR 563-1040

Martin Water Laboratories, Inc.

709 W INDIANA
MIDLAND TEXAS 7970
PHONE 683-4521

RESULT OF WATER ANALYSES

TO: Mr. Don Minter
P.O. Box 1600, Midland, Texas 79702

LABORATORY NO. 884495-A
SAMPLE RECEIVED 8-30-84
RESULTS REPORTED 9-7-84

COMPANY Exxon Company, U.S.A. LEASE Fogarty Creek
FIELD OR POOL La Barge
SECTION ___ BLOCK ___ SURVEY ___ COUNTY Sublette STATE WY
SOURCE OF SAMPLE AND DATE TAKEN:
NO. 1 Recovered water - taken from Fogarty Creek (sample #1). 8-29-84
NO. 2 Recovered water - taken from Fogarty Creek (sample #4). 8-29-84
NO. 3
NO. 4
REMARKS: Samples submitted by Tom Lane

CHEMICAL AND PHYSICAL PROPERTIES	NO. 1	NO. 2	NO. 3	NO. 4
Specific Gravity at 60° F.	1.0248	1.0174		
pH When Sampled				
pH When Received	6.36	6.48		
Bicarbonate as HCO_3	1,818	1,501		
Supersaturation as $CaCO_3$	---	---		
Undersaturation as $CaCO_3$	80	145		
Total Hardness as $CaCO_3$	300	114		
Calcium as Ca	95	34		
Magnesium as Mg	15	7		
Sodium and/or Potassium	12,728	8,014		
Sulfate as SO_4	811	465		
Chloride as Cl	18,181	11,221		
Iron as Fe	42.9	19.1		
Barium as Ba				
Turbidity, Electric				
Color as Pt				
Total Solids, Calculated	33,648	21,242		
Temperature °F.				
Carbon Dioxide, Calculated	1,200	781		
Dissolved Oxygen, Winkler				
Hydrogen Sulfide	160	350		
Resistivity, ohms/m at 77° F.	0.232	0.350		
Suspended Oil				
Filtrable Solids as mg/l				
Volume Filtered, ml				

Results Reported As Milligrams Per Liter

Additional Determinations And Remarks

Form No. 3

By _____
Waylan C. Martin, M.A.

TABLE I-3

P O BOX 1468
MONAHANS TEXAS 79756
PH 943-3234 OR 563-1040

Martin Water Laboratories, Inc.

709 W INDIANA
MIDLAND TEXAS 79701
PHONE 683-4521

RESULT OF WATER ANALYSES

LABORATORY NO. 1184174-A
SAMPLE RECEIVED 11-9-84
RESULTS REPORTED 11-16-84

TO: Mr. Steve Spence
2000 Classen Center East, Oklahoma City, OK

COMPANY Exxon Company, U.S.A. LEASE
FIELD OR POOL Dry Piney
SECTION BLOCK SURVEY COUNTY Sublett STATE WY
SOURCE OF SAMPLE AND DATE TAKEN:
NO. 1 Produced (Nugget) water - taken from Dry Piney field.
NO. 2
NO. 3
NO. 4
REMARKS:

CHEMICAL AND PHYSICAL PROPERTIES	NO. 1	NO. 2	NO. 3	NO. 4
Specific Gravity at 60° F.	1.0638			
pH When Sampled				
pH When Received	6.71			
Bicarbonate as HCO_3	322			
Supersaturation as $CaCO_3$				
Undersaturation as $CaCO_3$				
Total Hardness as $CaCO_3$	6,250			
Calcium as Ca	2,160			
Magnesium as Mg	207			
Sodium and/or Potassium	35,624			
Sulfate as SO_4	1,267			
Chloride as Cl	58,236			
Iron as Fe	13.6			
Barium as Ba				
Turbidity, Electric				
Color as Pt				
Total Solids, Calculated	97,816			
Temperature °F.				
Carbon Dioxide, Calculated				
Dissolved Oxygen, Winkler				
Hydrogen Sulfide	0.0			
Resistivity, ohms/m at 77° F.	0.096			
Suspended Oil				
Filtrable Solids as mg/l				
Volume Filtered, ml				

Results Reported As Milligrams Per Liter

Additional Determinations And Remarks

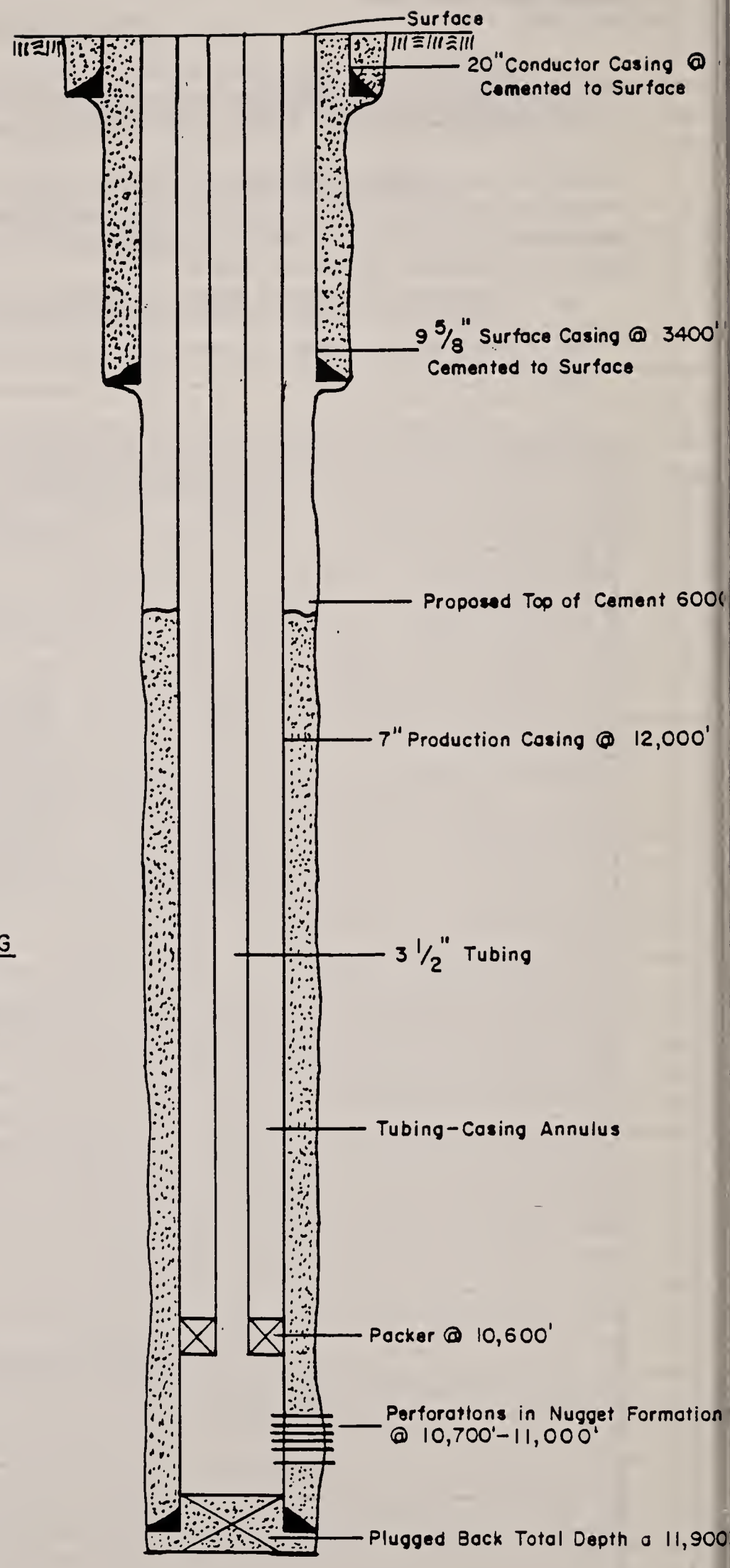
Form No. 3

cc: Mr. O.W. Davenport, Midland

By
Waylan C. Martin, M.A.

PROPOSED METHOD FOR TESTING THE CASING BEFORE USE

In the completion procedure for the disposal wells, after the packer is installed, the tubing-casing annulus will be pressure tested to 2500 psi or maximum authorized injection pressure whichever is greater.



EXXON
LA LARGE DISPOSAL WELLS
PROPOSED DESIGN

FIGURE I-3

Source: Exxon Company, USA,, May 1985

Surface Facilities

The APD included in Appendix B, pages 17 thru 20 provides a detailed description of the surface facilities and associated needs (i.e., drilling pad dimensions, reserve pit dimensions and capacity, pit liner parameters, erosion control, topsoil placement, subsoil placement, access road, drilling water source, pad and access road surfacing, cleanup and restoration, and other specific surface construction/facility information.) Figure I-4 shows the drill pad layout for Well 2-35. This is typical of the other two. Figure I-5 shows the profile of the typcial wellhead during the life of the well.

A level drilling pad approximately 475 ft. x 310 ft. (3.4 acres) would be constructed for placement of the drilling rig, mud tanks, personnel trailers and other facilities. An average of 20 workers per rig would be on location at any time. A total of eight trailers, including living, office, and lab facilities would be maintained at the site.

An engineering plan illustrating existing and proposed grades, typical cross-sections, and proposed location of facilities is submitted for each site with the Application for Permit to Drill.

Waste water facilities, including a leach field and/or septic tanks, would be designed and constructed in accordance with Exxon's Permit #83-330R issued by the Wyoming Department of Environmental Quality. If a septic tank is used, the waste would be removed at required intervals to a permitted disposal site by a contract hauler.

Drill Site Construction

The major activities for drill site construction include construction staking, field review, grubbing of stumps and brush, topsoil stripping, excavation and embankment construction, surfacing, cleanup, stabilization of cut and fill slopes, and construction certification. Construction procedures would follow the guideline published in Roading Guideline for Oil and Gas Exploration on National Forest Lands, Bridger-Teton National Forest, (1984). Typical construction procedure would follow the defined and approved procedure described in Chapter II of the Exxon LaBarge Project Construction and Use Plan (CUP) for Field Drilling and Production Facilities.

Access Roads

Access roads would be constructed to support drilling operations and construction, and operation of the injection well facilities. The planned access roads are illustrated on Map I-1.

A total of 4900 feet (.9 miles) of new road construction would be required to access the well locations. Well no. 1-35 would require approximately 500 feet, Well No. 2-35 approximately 2600 feet and Well No. 3-2 approximately 1800 feet. A construction width of 50 feet and a permanent disturbance width of 25 feet would be required. Surfacing material would be obtained from the existing gravel pit located in the SW1/4 NE1/4 Section 26, Township 28 North, Range 114 West.

FIGURE 1-4

Typical drill pad layout

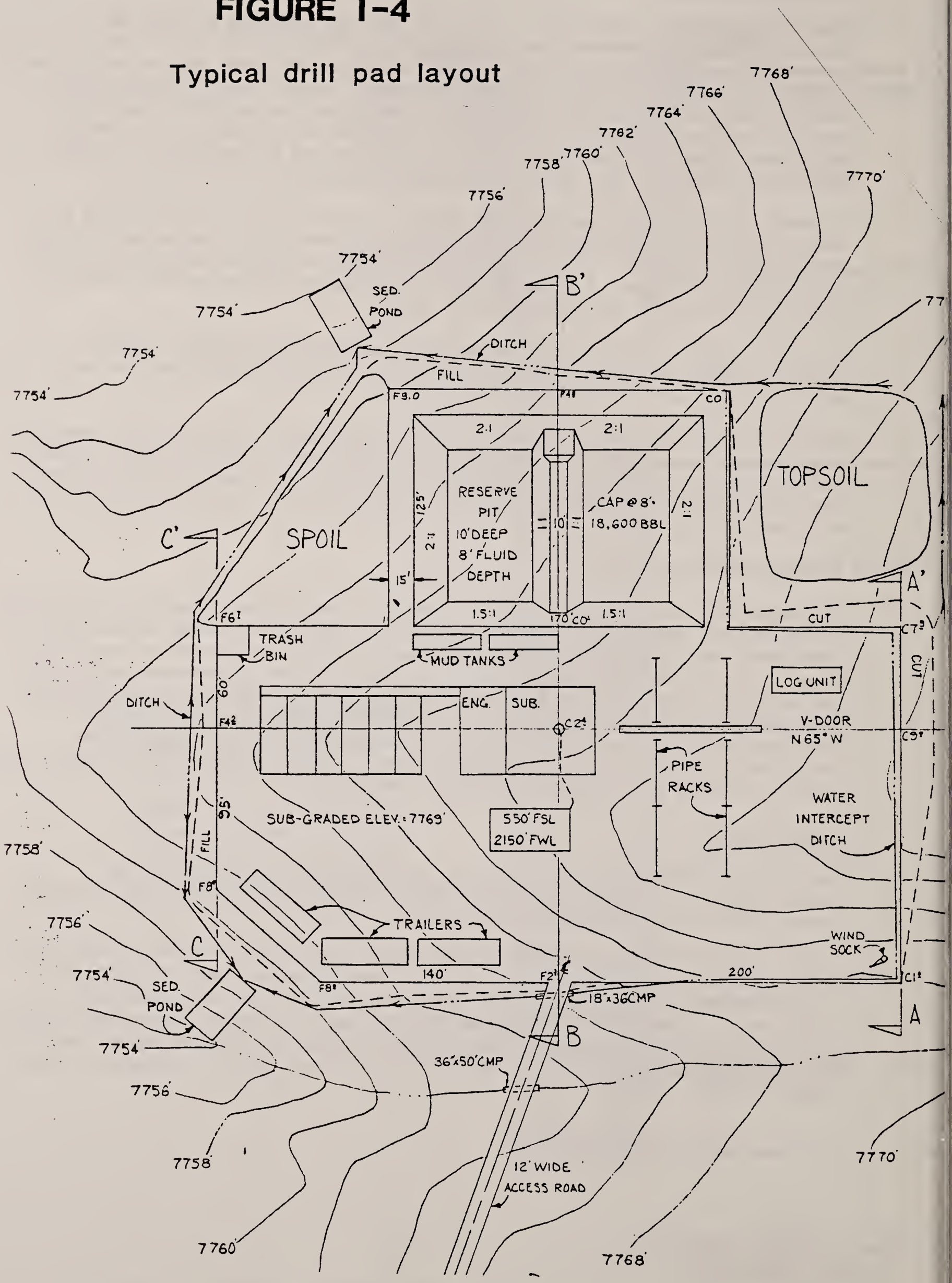
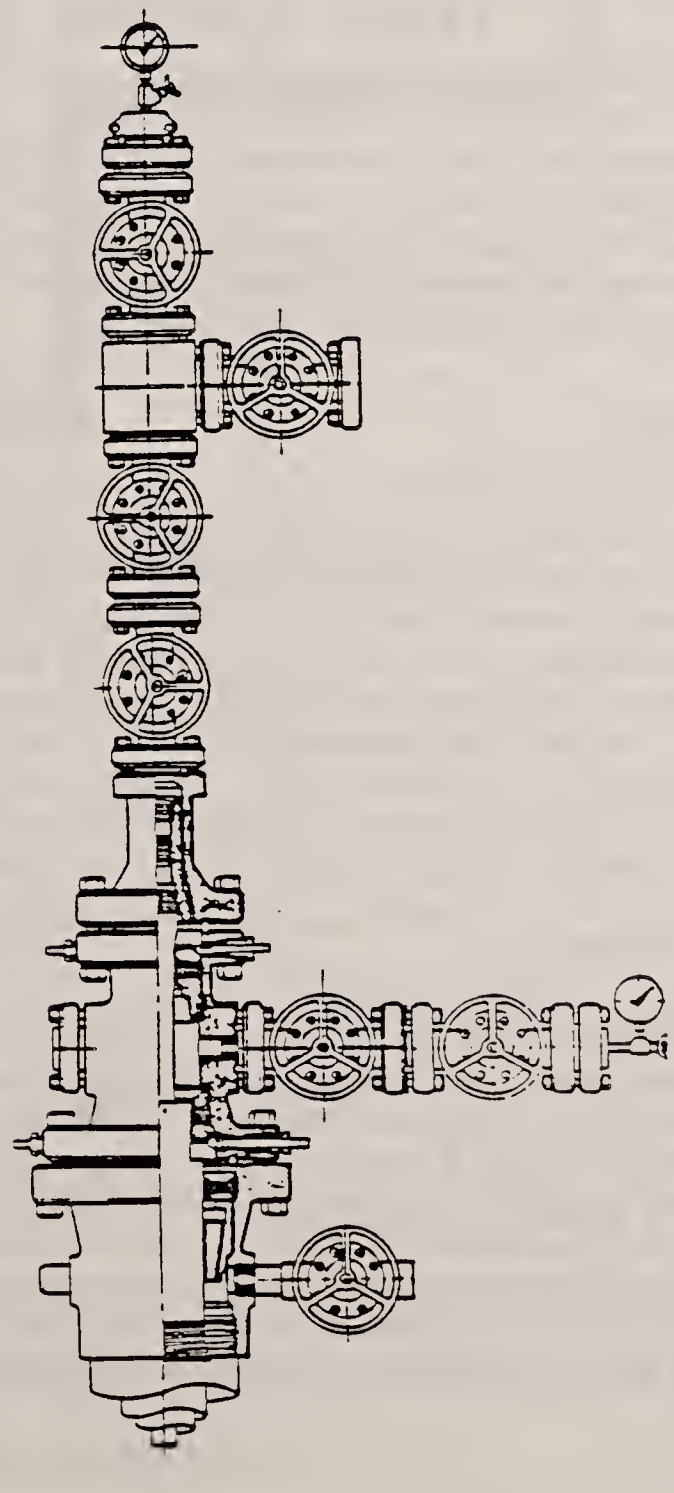


FIGURE 1-5

Profile of typical operational well head facility.



Access Road Design - Engineering

Specifications

Permanent roads necessary for access to project facilities would be designed for "all-weather" service by crowning, ditching, and surfacing with gravel or crushed aggregate. Design specifications and construction techniques would follow industry accepted practices and guidelines as well as those included in the following publications:

U.S. Forest Service Transportation Engineering Handbook, FSH 7709.11 (January 1981)

Forest Service Standard Specifications for Construction of Roads and Bridges (1979)

Roading Guidelines for Oil and Gas Exploration and Development on National Forest Lands, Bridger-Teton National Forest, (1984)

Surface Operating Standards for Oil and Gas Exploration and Development, USDI Bureau of Land Management and USDA Forest Service (1977)

Access Road Construction

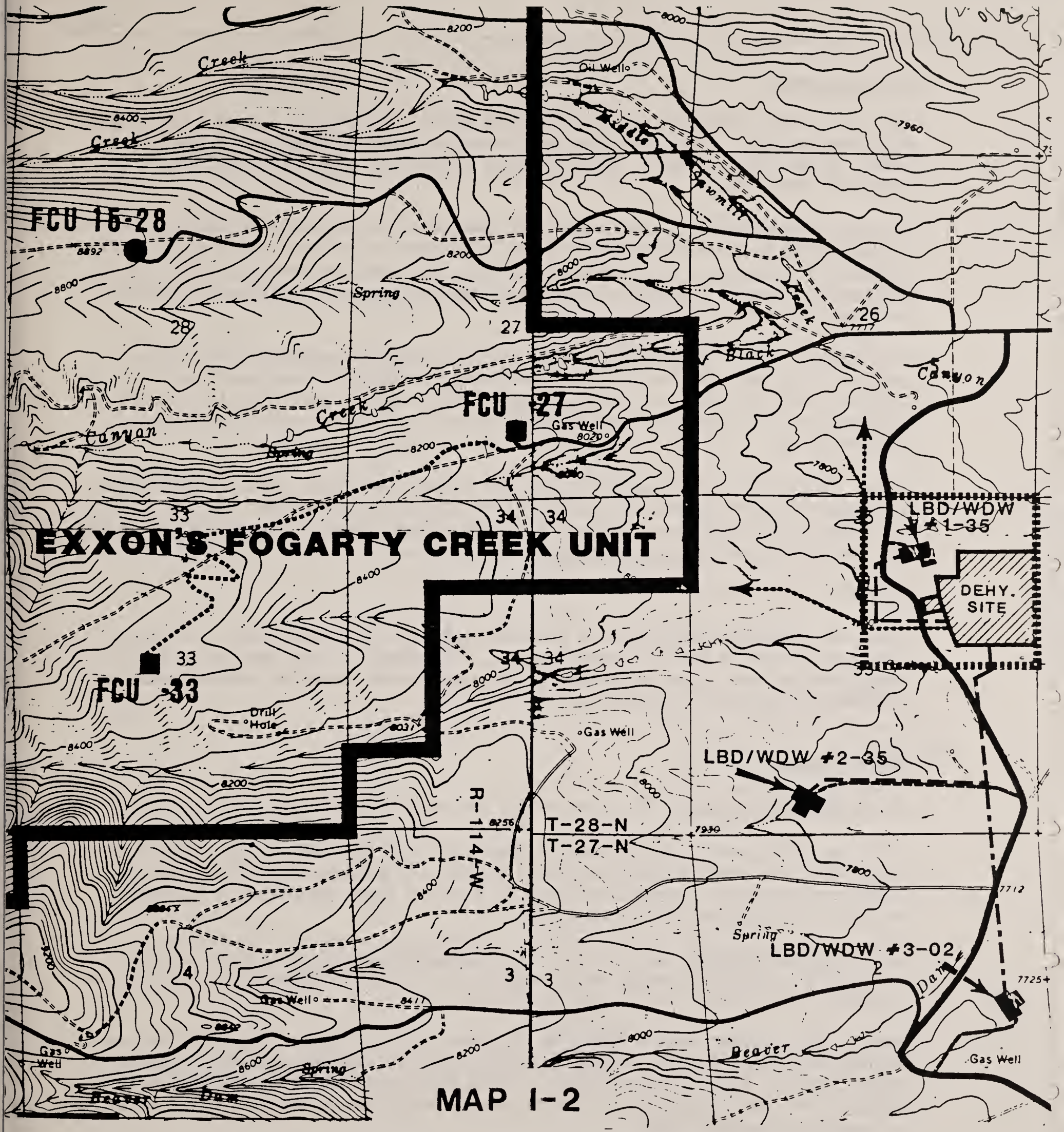
The major activities for road construction include construction staking, field review, clearing, grubbing of stumps and brush, topsoil stripping, excavation and embankment construction, construction of ditches and placement of drainage structures, surfacing, cleanup, stabilization of cut/fill slopes and construction certification. Typical construction procedure would follow the defined and approved procedure in Chapter II of the Exxon LaBarge project CUP for Field Drilling and Production Facilities.

Water Distribution

Approximately 2 miles (10,800 feet) of 4 - inch inside diameter fiberglass pipe, buried at a depth of nine feet, would be constructed to distribute the waste water from the dehydration facility to the injection wells (Map I-2). Three sets of three valves each would be located on each flow line and controlled at the water pump building located at the Dehydration Plant. A line break detector would automatically shut down waste water flow in the event of a leak. Manual valves would be located on either side of the automatic valve and at the well head. The pipeline design and construction techniques would be in accordance with those approved in Chapter II of Exxon's LaBarge Project CUP for Field Drilling and Production Facilities.

Pipeline Construction

Typically, pipelines would be laid in a continuous operation or a "spread", consisting of equipment and crews handling various types of construction activities for a given pipeline segment. The major activities would be: construction staking, field review, clearing, grading, trenching, stringing, line-up, jointing/coupling, coating/insulating field joints, lowering in pipe, backfilling trench, hydrostatic testing of pipeline, tie-in of pipeline, cleanup and restoration of site, and construction certification. Each of the major activities is briefly described in Chapter II of Exxon's LaBarge Project Construction and Use Plan for Field Drilling and Production Facilities.



MAP I-2

LaBARGE PROJECT WATER DISPOSAL FACILITIES

———— 1985 WATER DISPOSAL PIPELINE*/POWERLINE CORRIDOR (EST. 7500')

—·—·— FUTURE WATER DISPOSAL PIPELINE/POWERLINE CORRIDOR (EST. 3300')

····· WET GAS TRUNKLINE CORRIDOR

---------- ACCESS ROADS

SCALE: 1"- 2000'

W-A-8910

*4" I.D., 2000 lb. FIBERGLASS

5/15/85
SMW

Electric Power

Electric power would be supplied to each wellsite for use in heat tracing the well head piping. The powerline will be pole mounted adjacent to the access road - pipeline corridor. Approximately 2 miles of powerline would be required (Map I-2).

The power substation is located at the dehydration facility. Power will be stepped down from 69 kV to 13.8 kV for distribution to the well sites. Poles suitable for carrying 13.8 kV circuits will be used for power distribution. Figure I-6 shows a conceptual structure drawing for the distribution poles to the well sites.

When power is lost from UP&L, self-starting stand-by generators will come on-line. The generators will provide power to critical equipment loads at the dehydration site, and well site. Routinely scheduled generator tests will be performed for maintenance and to help ensure proper operation when actual outages occur.

Wires, conductors and insulators for the power lines will have a dull finish to reduce reflection and visibility. The design of electrical facilities will meet the requirements and suggested practices contained in Suggested Practices for Raptor Protection on Powerlines.

Powerline Construction

Powerline construction would be accomplished by area contractors. A typical crew consists of 6 men: 2 pole framers, 2 lineman, 1 hole driller and 1 journeyman helper. During construction, vegetation would be removed only as necessary to permit construction.

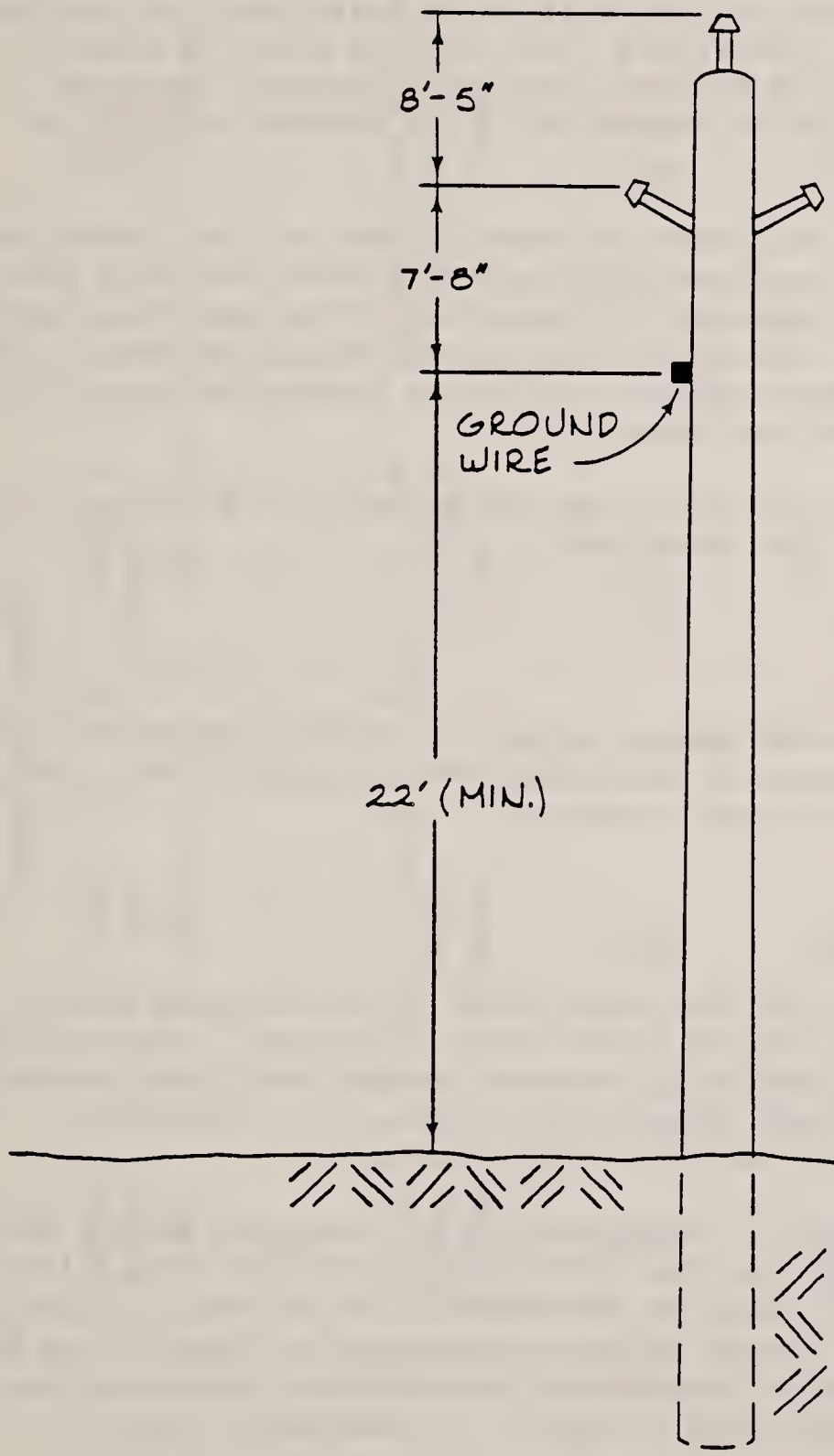
Waste Disposal

Drill cuttings would be disposed of in the reserve pit.

Drilling fluids would be allowed to temporarily evaporate in the reserve pit until the pit is dry enough for backfilling. If necessary to facilitate timely reclamation, excess fluid may be trucked from the pit by a licensed hauler to an approved disposal point.

Water produced during tests would be disposed of in the reserve pit. Oil produced during tests would be stored in test tanks until sold, at which time it would be hauled by truck from the site.

Sewage from trailer houses would be disposed of in a manner approved by the Wyoming Water Quality Division, Department of Environmental Quality, under Exxon Company, U.S.A. State Permit. This would consist of either a septic system with leach field, or a closed system with sewage periodically hauled to an approved disposal site.



NOTES

1. NOMINAL POLE HEIGHT - 40'
2. FINAL GUYING, BRACING, DETAILS AND DIMENSIONS WILL BE DETERMINED BY THE GROUND SURVEY AND ENGINEERING

FIGURE 1-6

CONCEPTUAL STRUCTURE DRAWING DISTRIBUTION LINE (WELLSITES)	EXXON COMPANY, U.S.A. A DIVISION OF EXXON CORPORATION PRODUCTION DEPARTMENT		
DRAWN B. D. ROSS CHECKED	ENGR SECTION LA BARGE REVISED APPROVED	SCALE NONE DATE 4/9/85	JOB NO	FILE NO

110-0004-1A

Trash, waste paper, and garbage would be contained in a trash bin to prevent wind scattering during collection. This trash would be hauled from the site and disposed of at approved garbage collection facilities.

When the rig moves out all trash and debris left at the site would be contained to prevent wind scattering and hauled to a garbage disposal facility off of the site.

Restoration Of Surface

In accordance with an approved detailed "Erosion Control, Revegetation and Restoration Plan", revegetation and rehabilitation would begin as soon as practical after completion of operations. Oil in pits would be removed or disposed of in a manner approved by the appropriate agency. Upon rig move-out, the reserve pit would be fenced and so maintained until it is backfilled and reshaped.

During the first appropriate construction season after drilling operations, pits would be backfilled and contoured with material from the spoil pile. The portion of the drill pad not required for water injection operations would be contoured to combat erosion. Stockpiled spoil would be distributed to the extent needed to recontour these areas. The entire stockpiled topsoil will be distributed on the areas to be reclaimed.

The detailed "Erosion Control, Revegetation and Restoration Plan" would be submitted after the well has been completed.

Monitoring

Exxon proposes to monitor the mechanical integrity of their proposed injection wells by monitoring the pressure in the casing-tubing annulus during actual injection, and reporting that pressure monthly.

ALTERNATIVES CONSIDERED

Although no unresolved conflicts were identified in the Proposed Action, four alternative methods of Waste Water disposal were considered. However, as the result of an overview of the potential resource changes/conflicts caused by the associated components of each alternative (Table I-4), all four alternatives were dropped from further consideration.

The overview provides comparative information on the Proposed Action and each alternative such that the environmental advantage, technical feasibility and/or reasonableness of each could be determined. On the basis of this, a decision whether to complete a more detailed assessment of impacts was made. The alternatives neither provide substantial environmental advantage nor reasonable methods of disposal under the given circumstances. The alternatives are as follows:

TABLE I-4
ALTERNATIVES TO
WASTE WATER DISPOSAL 1/
COMPARATIVE OVERVIEW

RESOURCE	PROPOSED ACTION ALT.	LINED PIT ALT.	AERIAL EVAPORATE ALT.	PURIFY RELEASE ALT.	SURFACE DISPOSAL ALT.
Visual Resources					
VRM Class 2/	III	III	III	III	(Release of toxic waste water onto the surface of the ground would violate existing State and Federal Regulation. This is not a viable alternative.)
Water Resources					
Dispoal Method	Wells (3)	Pond (200 acre)	Pond (100 + acre)	Discharge into Surface water	
Surface Water Impact Cause	Drilling	Overflow	Overflow	Potentially Significant	
Ground Water Impact Cause	Drilling; Injection	Seepage	Seepage	Seepage	
Soils/Vegetation					
Surface Acres Distorted					
Construction	30	200 +	100 +	20 to 40 +	
Operation	8	200	100 +	20 to 40 +	
Wildlife/Fisheries					
Habitat Affected (Acres)					
Construction	30	200 +	100 +	20 to 40	
Operation	8	200	100	20 to 40	
Migratory Birds		High loss to toxic water	High loss to toxic water	Unknown	
Technologically Feasible	Yes	Yes	Yes	No	Not Applicable
Meet Objective of Proposed Action	NA	Yes	Yes	Yes	No

1/ Based on a maximum disposal rate of 1 acre foot/day.

2/ Visual Resources Management Class III - Management activities must remain visually subordinate to the characteristic landscape.

No Action Alternative

No action would constitute BLM denial of the disposal well APD's and essentially the injection well method of waste water disposal. This would mean that other methods of waste water disposal would have to be considered. Four possible alternatives are (1) lined pit, (2) aerial evaporation; (3) purify and release, and (4) surface release. The following discusses these in more detail.

Lined Pit Alternative

This alternative, in accordance with the Bureau of Land Managements "Notice To Lessees and Operators" for disposal of produce water (NTL-2B), is one of the methods that could be used for disposal of produced and process waters. However, to handle the volume of water of concern (i.e., approximately 1 acre foot per day or 365 acre feet per year; using a 30-inch evaporation rate; and in consideration of a 50 year - 24 hour event) a 100 to 200 acre pit (depending on depth) would be required.

This alternative has been eliminated from further consideration because the water to be disposed of is water unfit for domestic, livestock, wildlife, irrigation or other use. The water would be essentially fresh with hydrogen sulfide dissolved in solution. Small amounts of additives (triethylene glycol, corrosion inhibitor) will be contained in the waste water.

The pit would attract waterfowl, waterbirds, and other wildlife species. An unquantified number of wildlife species would be killed unless special measures are taken to discourage wildlife entry.

The rate of evaporation may not be sufficient to maintain evaporation losses, particularly during the winter period. This could result in an overflow.

This alternative showed no environmental advantage over the proposed method of waste water disposal.

Aerial Evaporation Alternative

Aerial evaporation by spraying the waste water into the air would increase the evaporative rate. However, it would not eliminate the need for a large lined pit, or the potential loss of wildlife, among other impacts. Because this alternative showed no environmental advantage over the proposed method, it was eliminated from further consideration.

Purify And Release Alternative

Under this alternative waste water would be processed to a purity that would meet effluent quality levels of the Wyoming Water Quality Regulations and Standards. This assumes a water quality level equal to or greater than the natural quality of Black Canyon Creek. The cleaned (purified) water would be released into Black Canyon Creek, Dry Piney Creek and into the Green River.

Produced and condensed waters from the Exxon LaBarge Well Field may range from essentially fresh water to over 35,000 parts per million total dissolved solids. The facilities required to clean-up this water would be comparable to sea water desalination plants, which are highly complex. It is estimated that an additional 20 to 40 acres should be required at the dehydration facility. In addition, the facilities for the LaBarge produced water would have to operate over the whole ranmge of expected salinities. A National Pollutant Discharge Elimination System (NPDES) permit would be required for discharge into surface waters. A large quantity of salts would result from the purifying process and would have to be disposed of in an environmentally sound fashion.

The clean-up and surface disposal of produced water is not practiced in the oil industry. The technology has not been formalized to date to desalinate and remove the toxic chemical additives from produced and condensed water. Even if the technology were available an upset could be catastrophic. The magnitude of surface water pollution that could occur would be unacceptable. For these reasons the Purify and Release Alternative was considered an impractical and unreasonable alternative to subsurface injection of waste water. It was therefore dropped from futher consideration.

Surface Disposal Alternative

This alternative would discharge waste water out onto the ground and allow it to perculate into the ground. This alternative was eliminated from further consideration because the water quality would violate State of Wyoming Water Quality Regulations and Standards, as well as BLM NTL-2B Produced Water Disposal Regulations.

CHAPTER II

CHARGE

AFFECTED ENVIRONMENT/ENVIRONMENTAL CONSEQUENCES/MITIGATION

INTRODUCTION

The affected environment described in the Riley Ridge Natural Gas Project draft EIS and the supporting technical reports include the areas affected by the proposed waste water disposable wells. Therefore, the description of the affected environment will emphasize only those resource values for which there would be a change from that discussed in the EIS.

There would be no change in impacts for the following resources since the only difference is a function of on the-ground location: Socioeconomics, air quality, cultural resources, recreation, wilderness, timber resources, transportation networks, land use plans, controls and constraints, and noise. There would also be no change in the mandatory items listed below:

Wilderness values, Areas of Critical Environmental concern, and Wild and Scenic Rivers
Prime and Unique Farmlands
Cultural and Historical Resource Values
Threatened and Endangered Species

Resource impacts which differ, or which must be evaluated site-specifically, are those listed below:

Visual Resources
Water Resources/Water Quality
Wildlife and Fisheries
Soils and Vegetation
Agriculture/Grazing
Floodplains and Wetlands

Specific impacts are discussed below. If a project component would not affect a resource value it is not listed.

In accordance with the APD processing procedure described in Attachment D of the Riley Ridge Natural Gas Project Record of Decision, an interdisciplinary (ID) team of resource specialists completed an on-the-ground review of surface resources for the project area. ID Team reports were prepared and are included in Appendix D. Resource values of site-specific concern addressed in these reports are surface hydrology, soils, vegetation and aesthetics.

As identified in the Riley Ridge EIS and ROD, the effects on groundwater of deep well injection of wastewater could not be analyzed because of the lack of information. Information concerning the characteristics of surface and groundwater, and subsurface geology has been collected. However, this has only been done for the specific area affected by the proposed disposal wells. No attempt was made to complete a comprehensive assessment of surface and groundwater systems.

VISUAL RESOURCES

Waste Water Disposal Well #1-35 is located on private land. It lies within an area designated Visual Resource Management (VRM) Class III. The landscape condition is big sagebrush-grassland, bordered by aspen lowlands. Visibility is low.

Management activities remain visually subordinate to the characteristic landscape when managed according to this designation although they can be evident.

The proposed site is located within a small drainage, immediately adjacent to the dehydration plant site and is bordered on two sides by the road into the site. Visibility would be high due to traffic entering and leaving the plant.

Relocation of the proposed site out of the drainage floor and closer to the sideslopes would cause more landform alteration and greater impact. Visual impact is minimized by site location on the relatively flat area adjacent to the drainage bottom.

Permanent structures would be a noticeable, but subordinant, feature of the landscape. The buildings and associated facilities at the dehydration site dominate the surrounding landscape.

Waste Water Disposal Well #2-35 is also located on private land. It likewise lies within an area designated VRM Class III. The landscape condition is sagebrush grassland bordered by aspen lowlands. Visibility is low.

The proposed site is located on a rise between two small drainages, approximately one quarter of a mile from the dehydration plant site. It is well-screened by topography from surrounding viewpoints and is only visible from a gravel road approximately one eighth of a mile away. Potential viewers are not oriented toward the proposed site and views will be of very short duration.

Relocation of the proposed site to other immediate areas adjacent to the drainage bottom would result in a comparable degree of visual impact. Within this area slope and vegetative cover are relatively uniform.

Alternative sites out of the drainage bottom have potential for greater landform alteration, higher visibility, and increased visual impact.

Waste Water Disposal Well #3-2 is located on BLM land within an area designated VRM Class IV. The landscape condition is big sagebrush-grassland, bordering aspen lowlands. Visibility is low.

Management activities may visually dominate the original characteristic landscape. However, activities of vegetative and landform alteration must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristic are those of natural occurrances within the surrounding area or character type.

The proposed site is located on gently-sloping topography, approximately one mile south of the dehydration plant site. Visibility is unrestricted to the north and east, and the proposed site will be highly visible to potential viewers leaving the plant site and traveling south. A few trailers are located at Dry Piney Camp approximately one quarter of a mile south of the proposed wellsite. It is likely that construction-phase activities will be visible to them, but operation facilities will be screened by a small ridge.

No alternative sites were proposed or evaluated for this injection well. Any alternative in the immediate vicinity would have a comparable degree of visual impact.

Residual visual impacts created by the wellheads and operational well pads would be mitigated by painting the permanent structures a flat, noncontrasting color that is harmonious with the adjacent landscape. Implementation of erosion control and revegetation measures would be required to assure that lands disturbed by construction and operation activities are restored to a stable, productive, and aesthetically acceptable condition (Riley Ridge Record of Decision, Appendix B.5, Measure 4-2 and Appendix B.7).

WATER RESOURCES

AFFECTED ENVIRONMENT

A water Resources Technical Memorandum, prepared by Environmental Research & Technology, Inc. (ERT) as part of the Riley Ridge Natural Gas Project Environmental Impact Statement (EIS) preparation process, provides information on the water resources of potentially affected areas and discusses both surface water and groundwater quality. Sediment yield, stream flow frequency, water availability, acid deposition effects on wilderness lake water quality, and wastewater disposal methods are also discussed in that Technical Memorandum.

The overall objective of the water resources study was to compile sufficient data to assess potential impacts of the Riley Ridge Project on water quality and to develop control and mitigation plans.

Specifically, the study accomplished the following with respect to data needs for waste water disposal:

Collection and Evaluation of Existing Information. A comprehensive literature survey of existing data and information on surface water and groundwater hydrology and water quality was conducted. This information was obtained from local universities, the Bureau of Land Management, the Forest Service, the Geological Survey, the U.S. Soil Conservation Service, the U.S. Corps of Engineers, the Wyoming State Engineer, and other state and federal agencies. Additional data and information were collected from secondary sources, including unpublished literature, interviews, and field efforts.

Collection of Stream Water Chemistry Data. Water chemistry samples were collected from the 11 streams indicated in Table II-1. Water samples were taken three times during one year, corresponding to spring runoff, late summer flow (low flow, warmest water), and winter base flow (low flow, coldest water). A measurement of instantaneous discharge accompanied each water quality sampling to enable recognition of seasonal variations and trends.

Collection of Stream Sediment Data. Suspended sediment samples were collected from the seven streams listed in Table II-1. In addition to suspended sediment (mg/l) these samples were analyzed for turbidity (NTU) and correlated to instantaneous discharge measurements.

Analysis and Reduction of Sediment Data. Simple regression analyses were performed for each stream to determine the relationship of turbidity to suspended sediment.

Inventory of Springs and Wells. An aerial spring count was performed to document springs on the project area. Water wells registered with the Wyoming State Engineer were examined for suitability for use in gathering groundwater information.

Identification of Aquifers and Their Geologic Settings. This was primarily done through use of available literature.

Determination of Water Quality and Potentiometric Heads. Water quality samples were taken from springs and wells to help establish a baseline for the project area. Static water levels were also taken in all accessible wells.

Evaluation of Wastewater Disposal Methods. An evaluation of methods for wastewater disposal was conducted and recommendations were made regarding the most practical methods.

Analysis of Flow Frequencies. Flood peaks and volumes were calculated for the purpose of providing design flow information in the planning of bridges, road culverts, diversion ditches and stream diversion structures.

Surface Water

Two streams, Beaver Dam Creek and Black Canyon Creek, receive runoff from the area where the proposed disposal wells would be located. Three intermittent tributary drainages, one near each location, feed the two creeks which then flow into Dry Piney Creek which drains into the Green River (Map I-1).

TABLE II-1

SURFACE WATER SAMPLING PROGRAM

Stream Identification	Station Number	Water Chemistry	Stream Sediment
Pine Grove Creek	PG-1	3 Samples	26 Samples
Beaver Creek	B-2	3	
South Beaver Creek	SB-1		28
Porcupine Creek	P-1	3	23
South Piney Creek in Snider Basin	SP-2	3	
South Piney Creek below Snider Basin	SP-1	3	29
Coal Creek	C-1	3	
Fish Creek	F-2	3	20
Middle Piney Creek	SF-2	4	
Indian Creek	SF-1	1	
** Black Canyon Creek	BC-1	3	22
Fogarty Creek	FG-1	3	29
Beaver Creek below Spring Creek	B-1	3	
Total Samples/Year		33	173

** Black Canyon Creek is the only stream sampled by ERT during the water resources study that is located in the area of the proposed Exxon injection wells.

The primary source of stream flow is snow melt. Flows typically increase in direct response to runoff from precipitation events. Base flows are maintained by a limited amount of inflow from springs and seeps. Table II-2 provides water quality sample results for Black Canyon Creek. No data is available for Beaver Dam Creek. The Black Canyon Creek water quality sampling Station (BC-1) is downstream of the confluence with South Sawmill Creek and upstream of Dry Piney Creek. The sampling station is at about 7,710 feet elevation and the watershed is about 5.0 square miles in size. Water quality is generally good. Samples for this station were obtained only for September and May as the Creek was dry in January. Instantaneous flows measured at water quality sampling times were; no flow in January and 1.89 cfs in May. The stream channels are relatively stable in shape, dimension and gradient. Low erosion of channels and flood plains is evident.

Groundwater

Occurrence of groundwater in the Riley Ridge Natural Gas Project study area is highly variable due to the complex folding and faulting which has taken place in the geologic past. Where water is found, the quantity and quality is also highly variable.

Groundwater contamination is a problem in the study area. Contamination of water wells by hydrocarbons and salt water has been reported. The BLM is aware of these problems and is trying to identify sources of contamination and to develop preventive measures. New oil and gas wells on federal land in the Rock Springs District are now required to have surface casing set to below the known level of fresh water. Also, the Rock Springs District Office of the BLM has initiated a study of several hydrocarbon contaminated seeps in the Hogsback unit area. This study proposes: first, to mitigate the surface contamination caused by the seeps; and second, to determine whether they are a natural phenomenon or due to groundwater contamination by oil and gas activity.

Drilling and production of oil and gas is potentially detrimental to groundwater resources. Many problems can develop which will allow hydrocarbons or salty water to enter freshwater zones. It appears that these problems have occurred in the Riley Ridge-LaBarge area in the past. This issue is in the process of being addressed. Once defined, steps will be taken to correct existing problems and to minimize or avoid its occurrence in the future.

Some hydrogeologic reconnaissance work has been done in the area (Lines and Glass 1975; Welder 1968). The Water Resources Technical Memorandum contains the following hydrogeological delineations identified in the above reports:

> Wyoming Range. Large quantities of water may be present in limestone and dolomite aquifers in the Madison limestone, Darby Formation, and Bighorn Dolomite in the vicinity of large springs where there is solution permeability and a concentration of flow. There are also large volumes of rock with low permeabilities. The availability of water from these limestone and dolomite aquifers is quite variable. Water from the Darby, Madison, and Bighorn usually contains 100 to 250 mg/l of dissolved solids.

TABLE II-2

Black Canyon Creek (BC-1)

Parameter (mg/l except as noted)	Black Canyon Creek (BC-1) Sept	Jan	May
Date	11	19	24
Field Measurements			
Flow (cfs)	1.27	2	1.89
Temperature (°C)	6.0		13.0
pH	8.15		7.60
Conductivity (µmhos/cm @ field temp)	700[1]		360
Conductivity (µmhos/cm corrected to 25°C)	966[1]		446
Dissolved Oxygen (mg/l)	9.5		7.4
Alkalinity (as $CaCO_3$)	235.47		254.02
Lab Analysis			
Alkalinity (as $CaCO_3$)	239		244
Aluminum	<0.2		<0.2
Arsenic	<0.002		<0.002
Barium	<0.2		<0.2
Bicarbonate (as $CaCO_3$)	239		244
Cadmium	<0.005		0.005
Calcium	48		50
Carbonate (as $CaCO_3$)	0		0
Chloride	5		3
Chromium	<0.02		<0.02
Conductivity (µmhos/cm @ 25°C)	460		480
Copper	<0.02		<0.02
Lead	<0.02		0.03
Magnesium	32		32
Manganese	<0.03		<0.05
Mercury	<0.001		<0.001
Nitrogen, Nitrate	<0.02		<0.02
Oil and Grease	<1		2
pH (units)	8.46		8.0
Phosphorus, Total	<0.1		0.1
Potassium	1.1		0.7
Selenium	<0.002		<0.002
Silica	5.5		5.9
Sodium	3		4
Dissolved Solids	255		210
Sulfate	12		19
Zinc	<0.005		0.009

[1]Lab value considered more reliable.

[2]Stream was not flowing.

Western Green River Structural Basin. Individual sandstone aquifers in the LaBarge Member of the Wasatch Formation are capable of yielding small quantities of water to wells. The conglomerate is well sorted. Rocks of the Bridger Formation are relatively impermeable and yield very little water. Water in the project area of this basin commonly contains 500 to 1,000 mg/l of dissolved solids.

Well and Spring Water

The water resources study investigated five wells and five springs for water quality. (see Map II-1 and II-2). Two additional wells were measured for static water only. Data collected for wells are presented in Table II-3. All the wells sampled are completed either in alluvium, the Wasatch Formation, or both. Whenever possible a water level measurement was made. Well data and spring data are discussed separately in the following sections.

Well Water Quality - In general, well water quality was fair to moderate throughout the study area with high TDS, fairly high alkalinity, high conductivity, high sodium, and high sulfate concentrations. Field measured pH values ranged from 5.04 to 8.28. Field conductivity values corrected to 25°C were high and ranged from 429 micromhos/cm to 1,452 micromhos/cm. Total alkalinity values (measured as $CaCO_3$) were quite high and ranged from 201.3 mg/l to 408.7 mg/l. Total dissolved solids were high and ranged from 275 mg/l to 1,000 mg/l. Total anions measured ranged from 5.3 mg/l to 15.8 mg/l, and total cations ranged from 5.2 mg/l to 15/9 mg/l.

Several parameters were not detected in the well water. These parameters were:

Aluminum	Copper
Arsenic	Manganese
Barium	Mercury
Chromium	Selenium

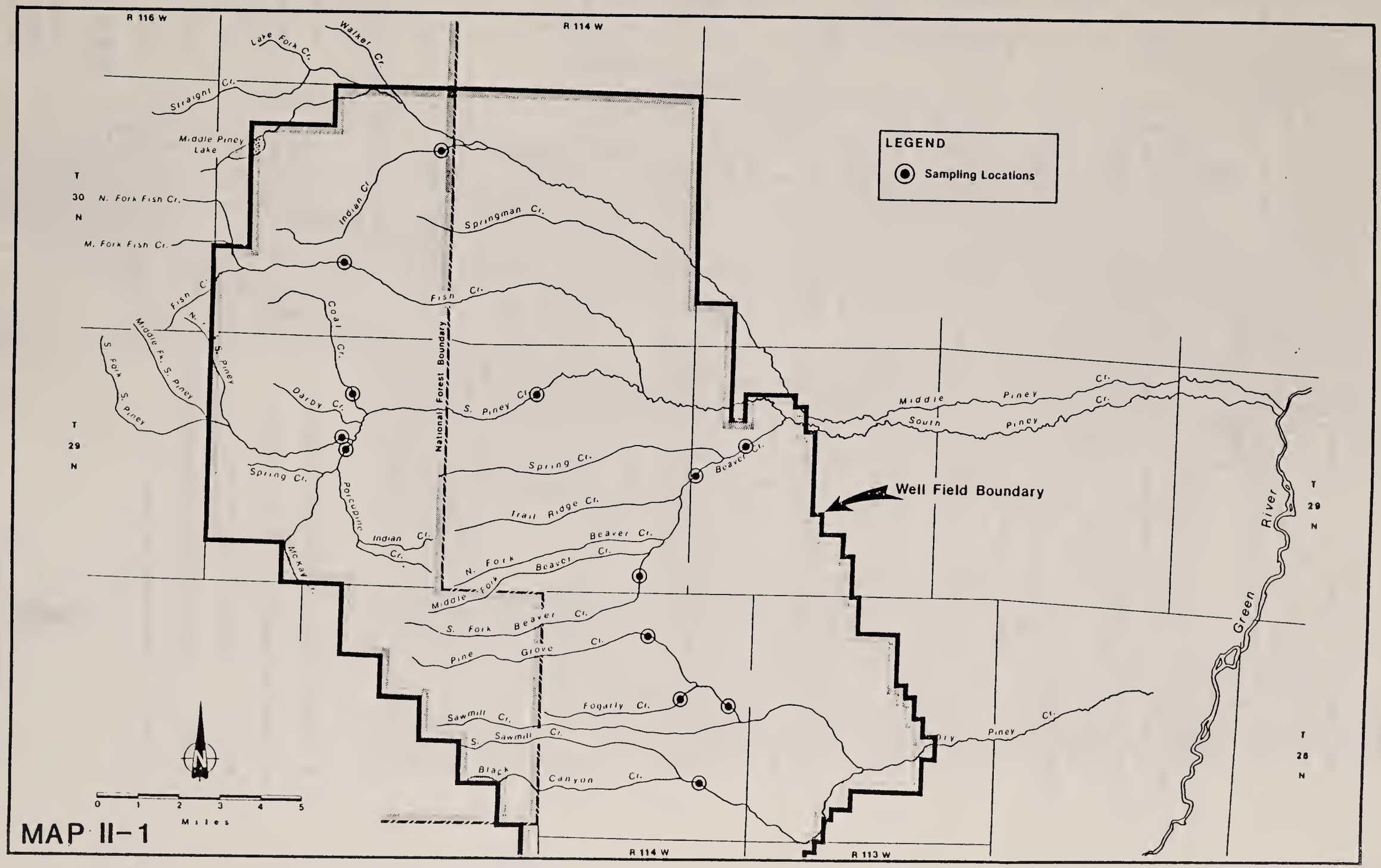
Measurable concentrations were detected in some of the wells for the following parameters:

Carbonate	Nitrate
Chloride	Oil and grease
Lead	Phosphorus

Chloride concentrations were relatively high and ranged from less than 1 mg/l (for the D. H. Budd well) to 77 mg/l.

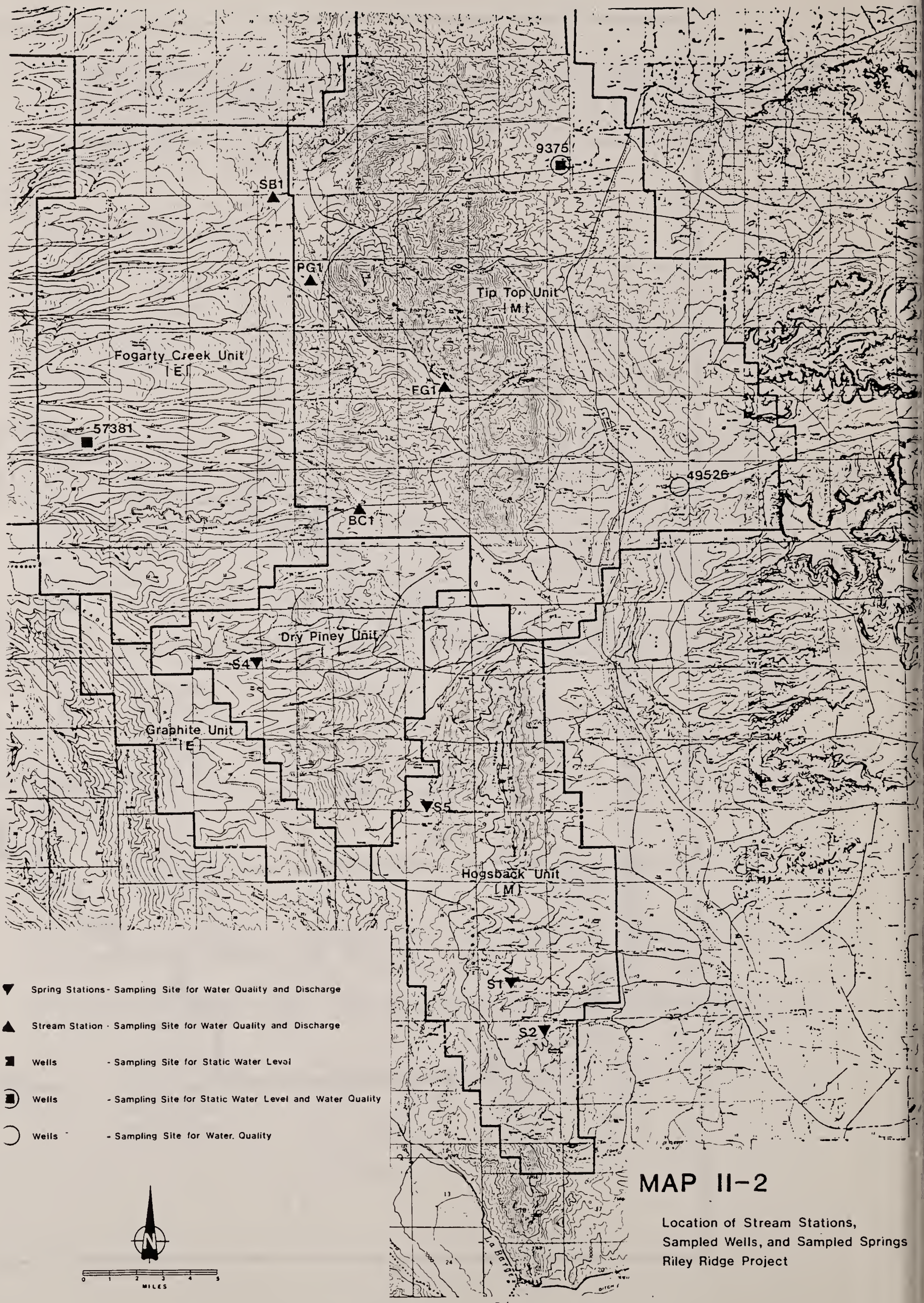
The following elements were detected in measurable concentrations for all of the wells sampled:

Bicarbonate	Silica
Calcium	Sodium
Magnesium	Sulfate
Potassium	Zinc



MAP II-1

STREAM FLOW AND WATER QUALITY SAMPLING LOCATIONS



MAP II-2

Location of Stream Stations, Sampled Wells, and Sampled Springs
Riley Ridge Project

TABLE II-3

WELL WATER QUALITY DATA

Parameter (mg/l except as noted)	Well Number						
	D.H. Budd[1]	Big Piney #1	9375	9355	49526	9618[2]	5781[2]
Date	7/12/83	7/13/83	7/13/83	7/13/83	7/14/83	7/14/83	7/15/83
Field Measurements							
Depth to Water from ground surface	[3]	[3]	55.10	145.0	[4]	70.48	238.82
Temperature (°C)	9.0	9.0	13.0	9.0	5.5		
pH	8.28	7.68	5.04	8.06	7.33		
Conductivity (µmhos/cm @ field temp)	325	600	510	1,100	550		
Conductivity (µmhos/cm corrected to 25°C)	429	792	652	1,452	764		
Alkalinity (as $CaCO_3$)	201.3	408.7	314.15	348.62	312.32		
Lab Analysis							
Alkalinity (as $CaCO_3$)	186	365	280	307	285		
Aluminum	<0.2	0.2	<0.2	<0.2	<0.2		
Arsenic	0.003	<0.002	<0.002	<0.002	<0.002		
Barium	<0.2	<0.2	<0.2	<0.2	<0.2		
Bicarbonate (as $CaCO_3$)	174	365	280	288	285		
Cadmium	0.005	<0.005	<0.005	<0.005	<0.005		
Calcium	11	41	57	23	80		
Carbonate (as $CaCO_3$)	12	0	0	18	0		
Chloride	<1	11	17	31	77		
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02		
Conductivity (µmhos/cm @ 25°C)	710	1,010	760	1,470	890		
Copper	<0.02	<0.02	<0.02	<0.02	<0.02		
Lead	<0.02	<0.02	0.14	<0.02	0.05		
Magnesium	5	51	31	15	44		
Manganese	<0.02	<0.02	<0.02	<0.02	<0.02		
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001		
Nitrogen, Nitrate	0.11	0.55	0.10	0.06	<0.02		
Oil and Grease	<1	2	<1	2	<1		
pH (units)	7.8	7.9	7.7	8.3	7.8		
Phosphorus, Total	0.02	0.02	<0.02	<0.02	<0.02		
Potassium	1.7	2.1	2.3	2.4	2.1		
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002		
Silica	8.3	11.5	17.1	6.9	11.1		
Sodium	95	112	58	306	47		
Dissolved Solids	275	630	470	1,000	620		
Sulfate	72	150	72	420	68		
Zinc	0.070	0.021	0.225	0.085	0.017		
Anions meg/l	5.3	10.8	7.6	15.8	9.3		
Cations meg/l	5.2	11.2	8.0	15.9	9.7		

Metals are dissolved unless otherwise noted.

[1]Privately owned well.

[2]No sample taken.

[3]Sampled from tap.

[4]Sampled from valved line.

Bicarbonate values ranged from 174 mg/l to 365 mg/l. Calcium levels ranged from 11 mg/l to 80 mg/l. Concentrations of magnesium ranged from 5 mg/l to 51 mg/l. Potassium levels were low, being close to detection limits, with concentrations ranging from 1.7 mg/l to 2.4 mg/l. Silica levels ranged from 6.9 mg/l to 17.1 mg/l. Sodium levels were high, with values ranging from 47 mg/l to 306 mg/l. Sulfate levels were also quite high and concentrations ranged from 68 mg/l to 420 mg/l. Zinc levels were quite low with concentrations ranging from 0.017 mg/l to 0.225 mg/l.

The wells are thought to be completed either in alluvium (D. H. Bud, 9375) or the Wasatch Formation (Big Piney #1, 9355, 49526). The wells were completed as production wells and not monitoring wells so many of the wells are completed in other zones besides those of interest.

Wells were chosen for sampling during the study for their accessibility first and formation they might sample second. Aquifers mentioned previously besides those in the Wasatch formation had no samples collected from them. Well data should be used to represent the baseline conditions in wells where collected and not for extrapolation of conditions elsewhere in the study area.

Spring Water Quality - Springs sampled are shown on Map II-2 (Spring S-6 is not shown). Spring water quality data are given in Table II-4. Except for springs S-1, spring water quality was generally good. Water quality at spring S-1 was fair. Flows ranged from 0.007 cfs to 0.013 cfs. Water temperatures ranged from 3.5°C to 8.5°C. Field measured pH values were close to neutral, ranging from 6.90 to 7.50. Field conductivity values corrected to 25°C ranged from 392 micromhos/cm to 1,762 micromhos/cm. Dissolved oxygen values ranged from 7.8 mg/l to 9.7 mg/l and were close to saturation levels. Total alkalinity values (measured as $CaCO_3$) ranged from 145.6 mg/l to 868.4 mg/l. Total dissolved solids were high and ranged from 260 mg/l to 1,245 mg/l. Total anions measured ranged from 5.0 mg/l to 23.1 mg/l and total cations ranged from 4.9 mg/l to 16.7 mg/l.

Several parameters were not detected in the spring water. These parameters were:

Arsenic
Carbonate
Copper
Lead
Mercury
Selenium

Measurable concentrations were detected in some springs for the following parameters:

Aluminum
Barium
Cadmium
Chromium
Manganese
Nitrate
Phosphorus
Zinc

The following elements were detected in measurable concentrations for all of the springs:

Bicarbonate
Calcium
Chloride
Magnesium
Oil and grease
Potassium
Silica
Sodium
Sulfate

TABLE II-4

SPRING WATER QUALITY DATA

Parameter (mg/l except as noted)	Station S-1[2]	S-2	S-4	S-5	S-6
Date	10/17/83	10/17/83	10/18/83	10/18/83	10/19/83
Field Measurements					
Flow (cfs)	0.01	0.007[1]	0.013	0.007	0.007[1]
Temperature (°C)	8.5	7.0	4.5	5.0	3.5
pH	7.25	6.95	7.05	7.50	6.90
Conductivity (µmhos/cm @ field temp)	1,325	290	345	390	340
Conductivity (µmhos/cm corrected to 25°C)	1,762	392	486	546	486
Dissolved Oxygen (mg/l)	7.8	8.3	9.5	9.7	-
Alkalinity (as $CaCO_3$)	568.4	170.8	145.6	246.0	226.0
Lab Analysis					
Alkalinity (as $CaCO_3$)	476	184	150	265	275
Aluminum	<0.2	<0.2	0.3	0.3	0.3
Arsenic	<0.002	<0.002	<0.002	<0.002	<0.002
Barium	<0.2	<0.2	<0.2	<0.2	0.4
Bicarbonate (as $CaCO_3$)	476	184	150	265	275
Cadmium	0.006	0.006	<0.005	<0.005	<0.005
Calcium	125	49	51	92	62
Carbonate (as $CaCO_3$)	0	0	0	0	0
Chloride	251	15	60	20	4
Chromium	<0.02	<0.02	0.03	0.02	0.04
Conductivity (µmhos/cm @ 25°C)	2,320	390	550	860	510
Copper	<0.02	<0.02	<0.02	<0.02	<0.02
Lead	<0.02	<0.02	<0.02	<0.02	<0.02
Magnesium	53	25	19	48	30
Manganese	2.57	<0.02	<0.02	<0.02	<0.02
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrogen, Nitrate	<0.02	1.40	<0.02	<0.03	0.17
Oil and Grease	2	1	1	2	2
pH (units)	7.62	8.15	8.29	7.97	7.88
Phosphorus, Total	<0.02	<0.02	0.06	0.02	0.03
Potassium	11.4	0.5	2.4	23.6	1.4
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002
Silica	5.8	6.0	8.2	9.7	11.8
Sodium	278	12	30	15	8
Dissolved Solids	1,245	260	285	630	330
Sulfate	<5	36	27	206	<5
Zinc	0.021	<0.005	0.035	0.031	0.031
Anions meg/l	23.1	5.0	5.2	10.2	5.7
Cations meg/l	16.7	4.9	5.5	9.8	5.9

Metals are dissolved unless otherwise noted.

[1]Estimated flow measurement.

[2]Spring was polluted by petroleum well above it.

Bicarbonate concentrations ranged from 150 mg/l to 476 mg/l. Calcium levels ranged from 49 mg/l to 125 mg/l. Chloride levels were generally high, ranging from 4 mg/l to 251 mg/l. Magnesium values ranged from 19 mg/l to 53 mg/l. Values for oil and grease ranged from 1 mg/l to 2 mg/l. Concentrations of potassium ranged from 0.5 mg/l to 11.4 mg/l. Silica levels ranged from 5.0 mg/l to 11.8 mg/l. Sodium concentrations ranged from less than 5 mg/l to 206 mg/l. Levels of sulfate varied from less than 5 mg/l to 206 mg/l.

Spring S-1 is downslope from an operating petroleum well. The integrity of the well and its connection to the springs are unknown and suspect. The water quality of the spring is much different than any around it. When spring S-1 was visited (October 1982) there was an oil slick on the water surface and the water had an odor of kerosene. Aspen trees below the spring had died, apparently from the high TDS and hydrocarbon content of the water. Since the parameter list was designed for characterization of baseline water quality in pristine streams, the presence of toxic substances remain undocumented.

Springs S-2, S-4, and S-6 are more similar to the surface water in that part of the study area than to any of the wells sampled. Spring S-5 is shown by Lines and Glass to be very near an outcropping of the Green River Formation. Though no fault is evident the water from S-5 is apparently from a deeper formation than those around it. S-5 is the only springs similar to the wells thought to be completed in the Wasatch Formation.

Injection Formation

A structural cross section of the Dry Piney Area and the proposed disposal well design are provided in Figures I-1 and I-3. Chapter I, pages 4 thru 6, provide a description of the injection formation.

The estimated depth at which the top and bottom of anticipated water, oil, gas or other mineral bearing formations are expected to be encountered are as follows:

	Top	Bottom
Fresh Water	0	3300'
Frontier Gas	6400	12,500'

ENVIRONMENTAL CONSEQUENCES/MITIGATION

Surface Water

Construction

Well Pad - The three proposed disposal wells would disturb approximately 4 acres each, or 12 acres total (see Figure I-4). Each of the three locations would be placed adjacent to tributary drainages to Black Canyon Creek (Well No. 1-35) and Beaver Dam Creek (Well No's. 2-35 and 3-2). Potential impacts to surface water that could occur are, increased sediment yield from the drill pad, contamination of water courses if the reserve pit fails, and localized channel aggradation/degradation.

Drilling water would be provided from existing water wells. Drilling water requirements (12 GPM or 4 acre feet per well) could cause the temporary draw-down of nearby existing wells if water is taken from the same zone. If the water needs are supplemented by water from Exxon's State permitted water diversion points (Map I-1), on Black Canyon Creek and Beaver Dam Creek localized effects on stream flow and water availability for other uses could occur temporarily. Low value fishery habitat exists below the already permitted state water diversion points (Map I-1). Black Canyon Creek does not always maintain yearlong flow, and Beaver Dam Creek does not maintain sufficient flow to support a fishery.

The above potential impacts would be mitigated by implementing the following measures:

Outside diversion ditches and sediment traps would be constructed to hold all sediment within the disturbed area of the drill pad and access road (Figure I-4).

The intermittent tributary to Black Canyon Creek contains a natural swale down drainage from the disturbance. This swale would contain any sediment that may be carried from Well No. 1-35 disturbed area in the event of runoff excursions.

All sediment control structures would be designed to convey flow velocities equal to or less than 2.5 feet per second.

Sediment control structures would be located out of small drainage channels and all sediment traps would be designed and constructed to minimize downstream erosion impacts.

Additional runoff control structures would be constructed if it is determined that the drill pad interferes with channel drainage.

All consumptive use of surface and ground water is controlled by the Wyoming State Engineer through the appropriation of water rights. Thus use of surface or ground water would either be purchased from the water right holder or obtained by permit from the State.

Access Road - A total of 4900 feet of new access road would be required for construction and drilling of the water wells (Well No. 1-35 = 500 ft.; 2-35 = 2600 ft.; and 3-2 = 1800 ft.). With a 50 foot construction width this would result in 5.6 acres of disturbance. Similar impacts to those described for the well pad could potentially occur.

Mitigation of access road impacts to surface water would be handled similar to that described for the well pad. In addition the following would occur:

Side ditches would be constructed at all cuts. Corrugated metal pipe and wing ditches would be installed to provide intermittent drainage and prevent erosion.

The access road would be surfaced with crushed aggregate or pit run gravel.

Pipelines - Approximately 10,800 feet of flow line (4 inch fiberglass pipe) buried at a depth of nine feet would be required to carry the waste water to the wells from the dehydration facility (Map I-2). Approximate flow line distances are: Well No. 1-35 = 2640 ft.; 2-35 = 5280 ft.; and 3-2 = 2880 ft. A 50 foot construction width would disturb 12.7 acres. Construction impacts to surface water would occur when crossing Beaver Dam Creek. Impacts could include direct removal of substrate during excavation, disruption of downstream substrate as a result of siltation from excavation and fill activities, and increases in turbidity levels. Degradation of water quality would be limited to a few days.

Impacts to Beaver Dam Creek are expected to be insignificant due to the short construction period and low flows.

Mitigation of pipeline impacts would be provided through compliance with the BLM-FS approved Exxon CUP for Field Drilling and Production Facilities.

Powerline - No impacts to surface water are expected during powerline construction.

Operations

Well head - No significant impacts to surface water would be expected from the operation and maintenance of the well heads at each of the well locations. The interceptor ditches and sediment traps will be retained in place following reclamation of the pads. Stabilization should occur within 3 to 5 years.

Access Road - No significant impact to surface water would be expected from the operational use and maintenance of the access roads.

Pipeline - No significant impact to surface water would be expected. However, a rupture of the line could cause the contamination of the stream waters and groundwater if a prolonged break were to occur.

Mitigation of this potential impact would be provided through automatic and manual valves. Three sets of three valves each would be located on each flow line and controlled at the water pump building located at the Dehydration Plant. A line break detector would automatically shut down waste water flow in the event of a leak. Manual valves would be located on either side of the automatic valve and at the well head.

Powerline - No significant impact would be expected from powerline operation and maintenance.

Abandonment

No significant impact to surface water would be expected from the abandonment of the pipeline and powerline. Removal of the well head and restoration of the access roads and operational well pad area would be required. Some increased sediment yield could occur until site stabilization. This sediment yield is not expected to reach the perennial streams.

At least one year prior to the abandonment of the facilities, Exxon would contact the Authorized Officer and arrange a joint inspection of the injection well(s) area. The inspection will be made to facilitate the preparation of an acceptable abandonment and rehabilitation plan. No abandonment and rehabilitation activities will be initiated without prior written approval of the plan by the Authorized Officer. The plan will include, but not be limited to, the removal of above ground facilities, drainage structures, and surfacing material; recontouring; replacement of topsoil; and establishment of vegetative cover.

At the end of the gas treating life, Exxon would obtain authorization from agencies, as appropriate to abandon the facilities. All facilities will be purged of contaminants. All above-ground facilities, foundations and electrical lines, would be removed. All salvageable materials would be removed for use elsewhere or sold. Unsalvageable materials would be disposed of at authorized disposal sites. All disturbed areas would be regraded and revegetated according to the procedures described in an approved Erosion Control, Revegetation and Restoration Plan(s). Abandoned right-of-way would be returned back to the control of the private landowner or land management agency as applicable. Reclamation of access roads would be at the discretion of the landowner or land management agency.

Ground Water

Construction

Well Drilling - The fresh water zone has been identified as occurring between 0 and 3000 feet (Figure I-1). Degradation of this ground water could occur primarily as a result of the drilling activity. Drilling wells through water and oil-bearing formations can cause contamination of fresh water by introducing oil and high concentrations of dissolved salts.

Drilling muds and additives used in well drilling operations could contaminate shallow alluvial aquifers if the reserve pit leaks. The probability of these impacts would depend on the design and construction of the reserve pit.

Mitigation measures would be employed to protect groundwater, and oil and gas formations from contamination during drilling. These would meet Wyoming Oil & Gas Conservation Commission and Bureau of Land Management drilling regulations and standards.

The drilling, casing, and cementing program, designed to protect important formations, would occur as follows:

1) Drill conductor hole, install conductor casing and cement the conductor casing-conductor hole annulus all to a depth of 80 feet.

2) Drill surface hole, install surface casing and cement the surface casing-surface hole annulus all to a depth of 3400 feet (100 feet below the bottom of the fresh water zone).

3) Drill production hole and install production casing to a depth of 12,950 feet. Cement the production hole-production casing annulus from the bottom up to the 6,000 foot depth (400 feet above the top of the first anticipated mineral bearing formation).

Operation

Waste Water Injection - Various geologic factors must be considered and evaluated before determining whether a particular formation is suitable for the disposal of waste water. Those geologic factors are listed in Appendix E. Potential significant impacts that could occur include: 1) Waste water migration and contamination of other formations as the result of adjacent formation fracturing; 2) Overpressuring the formation could cause future drilling hazards; 3) H_2S injection and diffusion to wells could cause corrosion of casing, unexpected production of H_2S, and encountering H_2S during drilling when not expected; 4) Pressure buildups in waste injection wells could cause rupture of casing or of confining units permitting the wastes to migrate to unintended aquifers; 5) The wastes could be incompatible with the rocks or the water in the injection zones, permitting clogging of the zones and excessive pressure buildup; and 6) Clogging or pressure buildup could alter the flow pattern of water in the formations receiving wastes and thereby force inferior water to the surface or into other aquifers.

An evaluation of the geologic factors shows that:

The Nugget Formation should be a good one for the injection of waste water. This formation is known to have sufficient porosity and permeability to qualify as a reservoir, and the formations above and below (Twin Creek and Ankareh) would provide seals to fluid and gas movement.

The proposed injection pressures (2200 to 2500 psi) should not facture the Nugget or adjacent formations. Nevertheless, a good monitoring system for checking pressures, flow rate and volume would be essential, as required in NTL-2B.

The Nugget may become overpressured in surrounding areas (approximately 1/2 mile radius) as a result of the injection. This would be a concern for future drilling. Further evaluation and computation shows the injection radius of the waste water (including H_2S), before any diffusion of H_2S occurs, would be 2041 feet (Table II-5) as opposed to the 2015 feet indicated in Exxon's application (See Figure II-1).

The amount of H_2S being injected (0.41% maximum concentration) is fairly small. With a concentration of H_2S at the surface of 0.41% of the total (by volume), in 50 years there would be 164,615 barrels of H_2S or 923,490 cubic feet. At or near the injected water front, the H_2S diffusion radius would extend an additional 7 feet past the injecion radius where the H_2S concentration becomes "infinitely small" (Table II-5).

The waste water being injected should not cause clogging.

The mechanical integrity of these wells would be maintained by monitoring the pressure in the casing-tubing annulus during actual injection, and reporting that pressure monthly.

A groundwater monitoring plan would be developed, implemented and maintained throughout the life of the project to monitor potential impacts on groundwater, provide quick detection of potential problems, and determine long-term water quality trends. Data trends monitored during injection will be compared to the pre-operational background data.

TABLE II - 5
Evaluation of Exxon's Estimate of Radial Injected Water
Influx into the Nugget Formation Around Each Disposal Well

Assumptions

- Average net pay thickness of 320 feet
- Average formation porosity of 8.5%
- Irreducible water saturation of 35%
- Bottom Hole temperature of 165° F
- Maximum H_2S concentration of .41%
- Average injection rate of 2200 bbl/day

Solution - Radius of injected water after 50 years

$$\text{Bbl injected} = \frac{7758 \times h \times A \times \emptyset \ (1-Swirr)}{Bw}$$

bbl injected = $2200 bbl/_{day} \times 365$ days x 50 yrs.
= 40,150,000bbl

h = thickness
A = Area = πr^2

$\emptyset$ = porosity
Swirr = Irreducible water saturation
BW = Water compressibility factor

BW = (1+(deltaVwp) (1+(deltaVwt)
BW = (1-.001)*(1+.027) = 1.026

$$40,150,000 = \frac{7758 \times 320 \times A \times .085 \times (1-.35)}{1.026}$$

A = 300,33 acres = 13,082, 375 ft^2
A = πr^2
r = 2041 ft = The radius of the injected water before any diffusion of H_2S occurs.

Assumptions

- The Molecular Weight of H_2S is 34.076 g/mole
- The diffusion coefficient of H_2S at 165°F is 8.17 x 10^5 $cm^2/_{sec}$ (delta)
- If the H_2S concentration at surface is .41% of the total (by volume), then there will be 164,615bbl or 923,490 ft^3 of H_2S

Solution - Radius of diffusion of H_2S after 50 years

PV = ZnRT

1 x 923,490 x 28.3168 = 1 x $\frac{\text{gram}}{34.076}$ x .0821 x 347

grams $_{H_2S}$ = 31,275,458

$$\frac{dQ}{dt} = (\text{delta}) \frac{dC}{dx} dy dZ$$

$$\frac{dQ}{dt} = 8.17 \times 10^5 \times .000005 \times \frac{dy}{dx} \times 320 \times 12 \times 2.54$$

$$\frac{dQ}{dt} = 39843 g/_{sec}$$

P = Pressure
V = Volume
Z = compressibility factor
n = number of moles
T = temperature

$dt = 784$

$m = (\text{delta}A * \frac{(d2-d1)}{h} * t$

$$31,275,458 = \frac{8.17 \times 10^5 \times (.000005) \times A \times 784}{320 \times 12 \times 2.54}$$

$A_2 = 95,249,015 cm^2 = 102,525.\ ft^2$

$A_1^2 + A_2 = A_T$

$130,82,375 + 102,525 = 13,184,900$

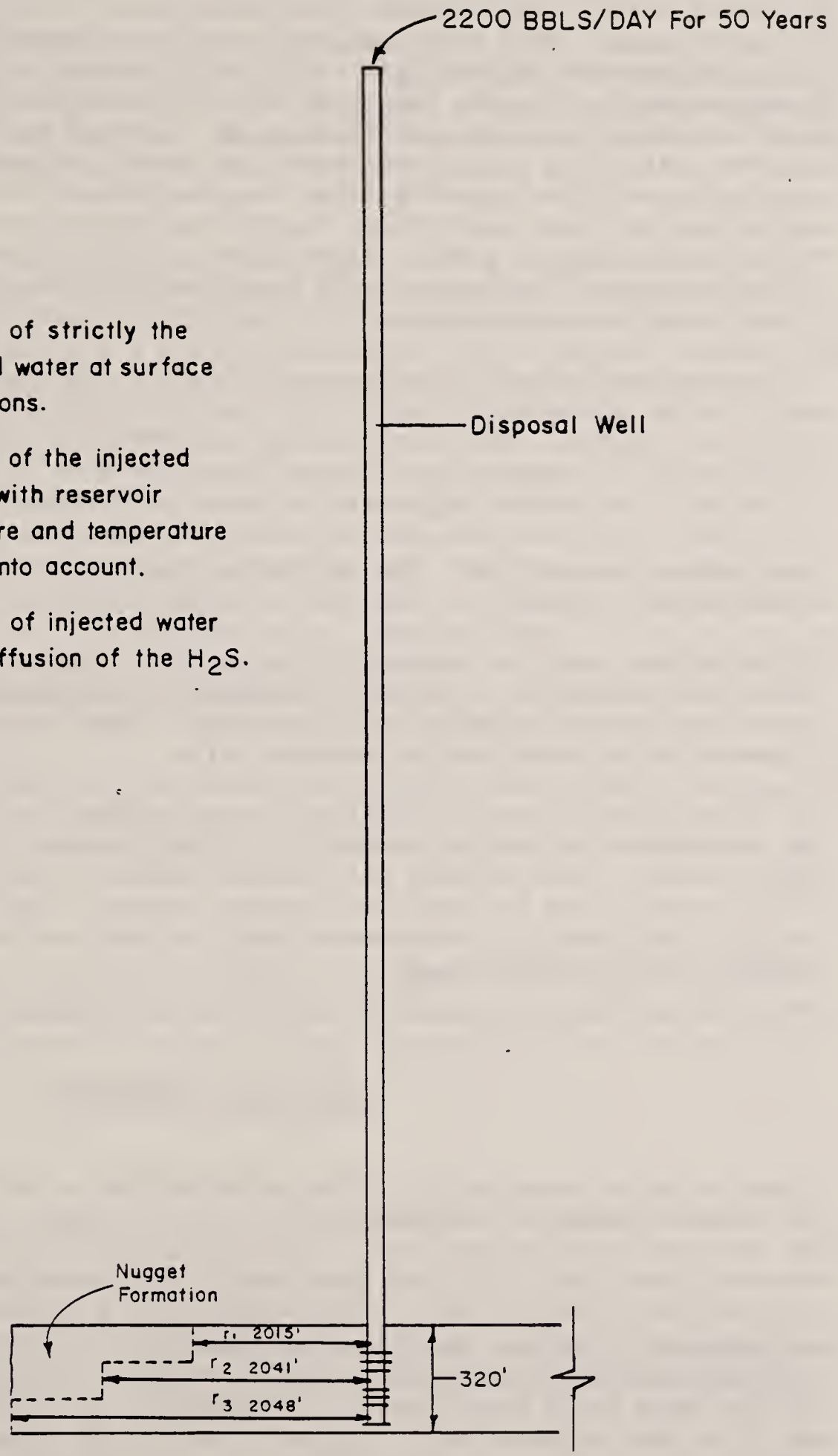
$A_T = \pi r^2$

$r = 2048$ ft Radius of injected water and H_2S after diffusion has caused the H_2S concentration to become infinitely small.

r_1 = 2015' Radius of strictly the injected water at surface conditions.

r_2 = 2041' Radius of the injected water with reservoir pressure and temperature taken into account.

r_3 = 2048' Radius of injected water and diffusion of the H_2S.



SCHEMATIC WELLBORE SKETCH SHOWING FIFTY YEAR WATER AND HYDROGEN SULFIDE (H_2S) INFLUX INTO NUGGET FORMATION

FIGURE II - 1

The methods of monitoring groundwater for impacts will be defined in the groundwater monitoring plan.

Abandonment

Potential significant impacts could occur from the abandonment of wastewater injection wells. The well bore could act as a conduit for the migration of poor quality water to aquifers which contain good quality water. Impacts can be minimized by properly cementing the entire cross sectional area of the well bore to isolate the zones containing the injected waste water and any aquifers present. Assuming all casing/cementing operations were performed in accordance with the approved APDs, the abandonment plugging program, as authorized by State and Federal regulation pertaining to abandonment of drilling operations, should ensure that no fluid migration will occur and that all minerals and fresh water will be protected from contamination or damage. Current regulations would require this type of abandonment procedure.

The abandonment plugging program would involve the following: A cement plug would be installed at the bottom of the production casing, and cement forced into the injection formations through perforations in the casing. The tubing string would be removed, and cement plugs would be placed at designated depths in the well to prevent migration of water or hydrocarbons and to protect any fresh water aquifers from contamination, in accordance with applicable state and federal regulations. The wellhead and casing would be cut off below ground level, capped with cement, and a marker erected.

All pipelines would be purged of waste water. The pipelines would then be sealed and abandoned in place, or removed for salvage, depending on existing environmental and economic considerations. Unsalvageable materials would be disposed of at an authorized disposal site.

The disposal wells would be plugged and abandoned according to requirements on the abandonment of wells covered by 1) WDEQ Chapter 9 Water Quality Rules and Regulations, 2) the Wyoming Oil and Gas Commission Rules and Regulations, and 3) BLM regulations for wells on federal leases. The same one year notification prior to abandonment would be required as described above for surface facility abandonment.

SOILS AND VEGETATION

A more detailed description of the affected soils and vegetation is found in the ID team reports in Appendix D.

Water disposal Well 1-35 has three soils associated with its location which is on relatively level terrain. All three would provide 12 inches of good-to-fair topsoil. The alluvial soil type could be difficult to salvage at 12 inches during the spring and early summer. A seasonal spring, fed by drifted snow would keep these soils saturated for a period of time. This soil may also have a potentially high salt content as is exhibited by the salt crust on the margin of this soil unit. For more detail see Tables 1 thru 4 of Appendix D-1.

Water disposal Well 2-35 has two soil types associated with its location. Both are on gently sloping ground that has been eroded and dissected. Twelve inches of soil material would be available in the mid portion of the location. Six inches would be available on the terraces of the north and south borders. For more detail see Tables 1 thru 4 of Appendix D-2.

Water disposal Well 3-2 has two soil types associated with its location. Both are on a gently sloping north-facing slope. Twelve inches of topsoil would be available in the southern portion of the location, while six inches would be available in the northern portion. The northern portion is restricted by high clay content in the subsurface horizon. For more detail see Tables 1 thru 4 of Appendix D-3.

The vegetation of the three disposal well locations is of the sagebrush complex. Well locations 2-35 and 3-2 are characterized by the dominance of the low sagebrush type. Well locations 1-35 is characterized by the dominance of the big sagebrush type and a moist grass-sedge type along the northern edge of the location. For a more detailed description of the vegetation see Appendix D-1, D-2, and D-3.

Construction

Construction of the well locations, access roads, pipelines and powerlines would temporarily disturb approximately 30 acres. A very small amount of riparian vegetation (1 to 2 acres) would be affected. Well location 3-2 and its associated facilities would not be constructed until 1986. Thus in 1985 an estimated 24 acres would be disturbed.

No significant impacts to soils would be expected provided topsoil removal and protection is accomplished in accordance with measures that would be specified in site-specific "Erosion Control, Revegetation, Restoration Plans."

Operation

During the operational life of the project (50 years) an estimated 8 acres would be taken out of production. All other disturbance would be reclaimed in accordance with an approved "Erosion Control, Revegetation and Restoration Plan".

Abandonment

No significant residual impact to soils or vegetation is expected upon abandonment of the disposal well facilities. All disturbances would be fully reclaimed.

Compliance with all the required measures identified in the Riley Ridge Record of Decision relative to soil protection, erosion control, reclamation and restoration would be stipulated.

WILDLIFE AND FISHERIES

No critical wildlife habitat occurs within the area of concern. Pronghorn and mule deer summer habitat and moose winter - yearlong habitat is found.

Black Canyon Creek provides low value fisheries habitat in areas downstream from the tributaries that drain the affected area. Lower Beaver Dam Creek does not support fish.

Construction

A total of approximately 30 acres of pronghorn and mule deer summer and moose winter - yearlong habitat would be disturbed. Beaver Dam Creek would be crossed by the pipeline but no fishery would be affected.

Construction activity would occur on Wells 1-35 and 2-35, and their associated access roads, pipelines and powerline during the summer of 1985. Well 3-2 would not be drilled until 1986. Thus, an estimated 24 acres would be disturbed in 1985 and 6 acres in 1986.

Operation

Approximately 8 acres of habitat would be taken out of production for the life of the project. All other disturbance would be reclaimed in accordance with the "Erosion Control, Revegetation, Restoration Plan."

One vehicle would make periodic trips (once a week) to each well head for maintenance purposes and well integrity testing. No road kills or poaching would be expected since travel would be from the dehydration facility. The furthest well (No. 3-2) would be two miles distance.

Abandonment

No significant impacts to wildlife or fisheries would be expected.

Mitigation - Compliance with all the wildlife and fisheries required federal measures specified in the Riley Ridge Record of Decision would be stipulated.

AGRICULTURE/GRAZING

Waste water disposal Well 1-35 is located on private surface owned by Exxon Corporation. Grazing would not occur on this parcel. Disposal Well 2-35 occurs on private surface owned by McGinnis. Exxons agreement with the surface owner would include consideration for grazing. Disposal Well 3-2 is located on federal surface administered by BLM. This grazing land is located within the LaBarge Individual Allotment (Tom Harrower, Allottee).

Construction

This well location, access road, and pipeline would disturb an estimated 6 acres of public land. This would result in the temporary loss of less than 1 AUM (animal unit month) of grazing (10 acre per AUM) during construction and for approximately 3 to 5 years following reclamation.

Operations

During operations an estimated 1 acre, (0.1 AUM) would be removed from production for the life of the project. Well head maintenance and associated vehicle travel (one vehicle per week) would not be expected to impact livestock use. Therefore, no significant impact to grazing operations would be expected.

Abandonment

Upon abandonment all disturbance would be fully reclaimed.

FLOODPLAINS/WETLANDS

Disposal Wells 1-35 and 2-35 are located adjacent to intermittent tributaries. Each year, for a period of time following snowmelt (1-2 months), the grass-sedge meadow land is subirrigated.

According to the U.S. Department of Housing and Urban Development (HUD), Flood Hazard Boundary Map (November, 1977), the subject well locations do not lie within floodplains. The drainages, to which Wells 1-35 and 2-35 are adjacent, are intermittent and do not meet the 100 year, 24 hour event criteria. Therefore, floodplain impacts are not expected.

The area is not classified as a wetland but rather a riparian area. It is a grass-sedge meadow area. See the Soils/Vegetation Section for further discussion.

UNAVOIDABLE ADVERSE IMPACTS

Proposed Action

Implementation of the BLM and FS committed and required federal mitigation measures would reduce impacts associated with the project as proposed. Impacts remaining following mitigation would be essentially as described in the Riley Ridge Natural Gas Project EIS (Pages 4-138 thru 4-140).

Of paramount concern is contamination of groundwater aquifers from the construction, operation and abandonment of the waste water injection wells. The Federal and State required measures would greatly reduce potential impacts to surface water and groundwater quality. Aquifer contamination would occur while drilling the wells through the water-bearing formations. The contamination would be from the drilling muds and additives used in the well drilling operations. The degree of contamination cannot be quantified but is expected to be small given the protective cementing program and current well drilling standards.

No unavoidable adverse operations impact has been identified. Monitoring of the wells and groundwater would occur throughout the life of the project.

No unavoidable adverse abandonment impacts would be expected. Proper cementing of the entire cross sectional area of the well bore to isolate the zones containing the injected waste water, oil and gas, and aquifers would be required according to current Federal and State regulation.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Significant impacts and consequences would not differ from those described in the Riley Ridge draft EIS (pages 4-141 and 142).

An irreversible committment of a resource is one which cannot be changed once it occurs. An irretrievable committment means that the resource cannot be recovered or reused. Given the Federal and State protective measures for drilling, operation, monitoring and abandonment, an irreversible or irretrievable committment of resources is not expected.

SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

Long-term environmental consequences would not differ from those described in the Riley Ridge Draft EIS (page 4-140).

CUMULATIVE IMPACTS

The cumulative impacts of the Proposed Action, and other changes that have taken place since the Riley Ridge Final EIS and Record of Decision, are not expected to differ from the cumulative impacts described in the Riley Ridge draft and final EIS.

CHAPTER III

CHAPTER III

MITIGATION AND MONITORING

All the "Required Federal Measures and Applicants' Standard Operating Procedures Designed to Reduce Environmental Impacts" listed in the Riley Ridge Natural Gas Project Record of Decision (Attachment B) will continue to be required. The Record of Decision reference to 30CFR Part 221 - Oil and Gas Operating Regulations (pages 8-16 and 17), has changed to 43CFR Part 3160 - Onshore Oil and Gas Operations. Specifically, these regulations include, in part, environmental and safety obligations (subpart 3162.5) that the lessee must comply with in relation to protection of fresh water and other minerals as well as shut down procedures in the event of noncompliance (subpart 3163). Additional mitigation measures that would be required for implementation of the proposed action are as described in Chapter II of this EA for each affected resource as well as the following:

1. The plan to be developed by Exxon (as specified in the Well Field Changes Decision Record, March, 1985) for the daily maintenance and operations visits to the well field sites shall include the disposal well locations and shall be incorporated into the Exxon LaBarge Project for Field Drilling and Production Facilities.

2. Exxon shall develop a Groundwater Monitoring Plan to be implemented and maintained throughout the life of the project. The objective/Purpose of the plan should be to monitor the groundwater in a manner that will provide quick detection of potential problems and to provide a means of determining long term trends due to waste water well injection. Data trends monitored during injection will be compared to the pre-operational trends.

   The Groundwater Monitoring Plan shall be developed and implemented in accordance with the Riley Ridge Natural Gas Project Record of Decision.

3. In the event operational monitoring of waste water disposal demonstrates that groundwater or surface water contamination is occuring, or that injection is not being confined to the injection interval, such that continued operatons could result in serious harm, the lessee shall immediately shut down injection operations associated with the deffective well(s).

CHAPTER IV

CHAPTER IV

CONSULTATION AND COORDINATION

This document was prepared by the Rock Springs District after consultation with Exxon Company, USA, the Pinedale Resource Area (BLM), the Kemmerer Resource Area (BLM), the Big Piney Ranger District, and the Forest Supervisor's Office of the Bridger-Teton National Forest. Consultation and coordination also occurred with the Wyoming Oil and Gas Conservation Commission (WOGCC), Wyoming Department of Environmental Quality - Water Quality Division, State Engineer's Office, and the U.S. Geological Survey - Water Resources Division.

Scoping was accomplished through the consultation noted above, and by utilizing the scoping comments received on the Riley Ridge EIS, follow-up action and contacts, public meetings held by BLM, public hearings conducted by the Wyoming Industrial Siting Council (ISC) and the Wyoming Department of Environmental Quality (DEQ), the distribution of Riley Ridge Project supplemental environmental documents and periodic preliminary scoping statements on well field development. Exxon has applied to WOGCC for a waste water disposal permit and to BLM for a drilling permit. These applications were also a source of information used in the preparation of this environmental assessment.

On May 22, 1985, the Bureau of Land Management, Rock Springs District, conducted a public meeting in LaBarge, Wyoming to review, discuss and receive comments on Exxon's LaBarge Project Phase II development and implementation plans. During that meeting a concern was expressed relative to the potential for contamination of domestic water wells in the proximity (i.e., Dry Piney Creek) of the disposal well drilling and operations. This concern has been given consideration in the assessment of potential surface water and groundwater impacts and in the assurance of protective mitigations.

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LaBarge Project, Construction and Use Plan, Field Drilling and Production Facilities.

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Application of Exxon Corporation for Salt Water Disposal, LaBarge Deep/Water Disposal Wells No. 135, 235 and 32, To Wyoming Oil & Gas Conservation Commission.

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U.S. Department of the Interior, Bureau of Land Management, January 1984.
Riley Ridge Natural Gas Project, Record of Decision.

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Water Quality Rules and Regulations - Chapter IX - Wyoming Groundwater Pollution Control Permit.

APPENDICES

APPENDIX A-1

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

Notice to Lessees and Operators
of Federal and Indian Oil and Gas Leases
(NTL-2B)

Disposal of Produced Water

This Notice supersedes NTL-2 and 2A and is issued pursuant to the authority prescribed in 30 CFR 221.4 and 221.32. Lessees and operators of onshore Federal and Indian oil and gas leases or fee and State leases committed to federally supervised unitized or communitized areas shall comply with the following requirements for the handling, storing, or disposing of water produced from oil and gas wells on such leases.

As used in this Notice, the term "District Engineer" means the District Engineer, U.S. Geological Survey. However, in the State of Alaska, the requirements of this Notice will be administered by the Area Oil and Gas Supervisor.

I DISPOSAL REQUIREMENTS AND APPLICATIONS FOR APPROVAL OF DISPOSAL METHODS

By October 1, 1977, all produced water from the above said leases must be disposed of by (1) injection into the subsurface; (2) lined pits; or, (3) by other acceptable methods. All such disposal methods must be approved in writing by the District Engineer regardless of the physical location of the disposal facility. Any method of disposal which has not been approved as of October 1, 1977, will be considered as an incident of noncompliance and will be grounds for issuing a shut-in order until an acceptable manner for disposing of said water is provided and approved by the District Engineer. Lessees and operators are encouraged to file applications in this regard as promptly as possible and are forewarned that applications for approval of existing disposal facilities which are filed after July 1, 1977, may not be timely approved.

No additional approval is required for facilities previously approved by the Geological Survey which involve the disposal of produced water into the subsurface or in lined surface pits. Likewise, no further approval is necessary for existing injection facilities utilized for pressure maintenance or secondary recovery operations.

Lessees and operators who are presently disposing of water in unlined surface pits must timely file applications with the District Engineer for approval of present or proposed disposal methods. Likewise, lessees and operators who are presently disposing of produced water in the subsurface or in lined surface pits without approval of the Geological Survey must also file applications for approval thereof by the District Engineer.

The District Engineer may require modification of any disposal facility prior to October 1, 1977, whenever it is determined that continued use of such facility is endangering the fresh water in the area or is otherwise adversely affecting the environment.

Any application to dispose of produced water must specify the proposed method of disposal and provide the information necessary to justify the method. Required information which must be included in applications for approval of produced water disposal in the subsurface, in lined pits, or in unlined pits is set forth in Sections II, III, and IV, respectively, of this Notice. Additional information may be required by the District Engineer in individual cases. Previous applications filed in response to NTL-2 and NTL-2A which do not meet the data requirements of this Notice must be supplemented or resubmitted.

A single application may be submitted for several leases or facilities provided that (1) the leases or facilities are located in the same field; (2) the produced water is from the same formation or is of similar quality; (3) the volume and source of the water is shown separately for each disposal facility; and, (4) the method of disposal is the same in every case.

II DISPOSAL IN THE SUBSURFACE

If approval is requested for subsurface water injection in connection with secondary recovery operations or for disposal purposes, the lessee or operator must furnish information which includes:

1. The designated name and number of the proposed disposal well and its location in feet and direction from the nearest section lines of an established survey. The applicable Federal or Indian oil and gas lease number or other permit and/or the ownership of the surface and minerals if other than Federal or Indian.

2. The daily quantity and sources of the produced water and a water analysis which includes total dissolved solids, pH, and the concentrations of chlorides and sulfates.

3. The injection formation and interval.

4. The quality of the fluids in the injection interval, i.e., total dissolved solids.

5. The depth and areal extent of all usable water (i.e., less than 10,000 ppm total dissolved solids) aquifers in the area.

6. The size, weight, grade and casing points of all casing strings, the size hole drilled to accommodate each string, the amount and type of cement, including additives used in cementing each string, and the top of the cement behind each casing string. In addition, bond logs may be required in certain instances.

7. The total and plugged back depth of the well.

8. The present or proposed method of completing the well for injection including the type and size of tubing and packer to be utilized, the setting depth of the packer, anticipated injection pressure, and information concerning any corrosion inhibitor fluid which is to be placed in the tubing-casing annulus.

9. Plans for monitoring the system to assure that injection is confined to the injection interval and measures to be taken should it be necessary to shut-in the disposal system.

In order to be approved, subsurface disposal must be confined (1) to formations which contain water of similar or poorer quality than the injected water or (2) to formations that contain water of such poor quality as to eliminate any practical use thereof.

In general, it will be required that subsurface disposal be accomplished through tubing utilizing a packer which is designed to hold pressure from above and below. The packer should be set at a depth where the casing is protected by competent cement but normally not more than 50 feet above the injection interval. Other procedures or methods of subsurface disposal may be approved by the District Engineer when justified by the lessee or operator.

III DISPOSAL IN LINED PITS

Where approval is requested for surface disposal in a lined pit, the lessee or operator must supply information which includes:

1. A topographic map of suitable scale which shows the size and location of pit.

2. The daily quantity, sources of the produced water, and a water analysis which includes the concentrations of chlorides, sulfates, and other constituents which are toxic to animal, plant, or aquatic life.

3. The evaporation rate for the area compensated for annual rainfall.

4. The method for periodic disposal of precipitated solids.

5. The type of material to be used for lining the pit and the method of installation.

6. The method to be employed for the detection of leaks and plans for corrective action should a leak occur in the liner.

The material used in lining pits must be impervious, weather-resistant, and not subject to deterioration when contacted by hydrocarbons, aqueous acids, alkalies, fungi, or other substances likely to be contained in the produced water. Lined pits constructed after the issuance of this Notice must have an underlying gravel-filled sump and lateral system or other suitable devices for the detection of leaks. The District Engineer shall be provided an opportunity to inspect the leak detection system prior to the installation of the pit liner.

IV DISPOSAL IN UNLINED PITS

Surface disposal into unlined pits will not be considered for approval by the District Engineer unless the lessee or operator can show by application that such disposal meets any one or more of the following criteria:

1. The water to be disposed of has an annual weighted average concentration of not more than 5,000 ppm of total dissolved solids, provided that such water does not contain objectionable levels of any constituent toxic to animal, plant, or aquatic life.

2. That all, or a substantial part, of the produced water is being used for beneficial purposes. For example, produced water used for purposes such as irrigation and livestock or wildlife watering shall be considered as being beneficially used.

3. The water to be disposed of is not of poorer quality than the surface or subsurface waters in the area which reasonably might be affected by such disposal or the surface and subsurface waters are of such poor quality as to eliminate any practical use thereof.

4. The volume of water to be disposed of per facility does not exceed five barrels per day on a monthly basis.

5. The specific method of disposal has been granted a surface discharge permit under the National Pollutant Discharge Elimination System (NPDES).

Applications for approval of unlined surface pits pursuant to exception Nos. 1, 2, 3, or 4, above, must include:

1. The daily quantity and sources of the produced water and for exception Nos. 1 through 3, a water analysis which includes total dissolved solids, pH, and the concentrations of chlorides and sulfates.

2. A topographic map of suitable scale which shows the size and location of the pit.

3. The evaporation rate for the area compensated for annual rainfall.

4. The estimated percolation rate based on the soil characteristics under and adjacent to the pit.

5. The depth and areal extent of all usable water (i.e., less than 10,000 ppm total dissolved solids) aquifers in the area.

Where beneficial use is the basis for the application, the justification submitted must contain written confirmation from the user(s) and the water analysis must also include the oil and grease content, temperature, and the concentration of other constituents which are toxic to animal, plant, or aquatic life.

If the application is made on the basis that surface and subsurface fresh waters will not be affected by disposal in an unlined pit, the justification must also include:

1. Analyses of all surface and subsurface waters in the area which might reasonably be affected by the proposed disposal.

2. Maps or plats showing the location of surface waters, fresh water wells, and existing water disposal facilities within two miles of the proposed disposal facility.

3. Reasonable geologic and hydrologic evidence showing that the proposed disposal method will not adversely impact on existing water quality or major uses of such waters; the depth of the shallowest fresh water aquifer in the area and the presence of any impermeable barrier(s).

4. A copy of any State order or other authorization granted as a result of a public hearing which is pertinent to the District Engineer's consideration of the application.

If the application is for disposal pursuant to an NPDES permit, only a topographic map showing the size and location of the pit together with a copy of the approved permit and the most recent "Discharge Monitoring Report" will be required.

V GENERAL REQUIREMENTS FOR PERMANENT SURFACE PITS

Lined and unlined pits approved for water disposal shall:

1. Have adequate storage capacity to safely contain all produced water even in those months when evaporation rates are at a minimum.

2. Be constructed, maintained, and operated to prevent unauthorized surface discharges of water. Unless surface discharge is authorized, no siphon, except between pits, will be permitted.

3. Be fenced to prevent livestock or wildlife entry to the pit, when required by the District Engineer.

4. Be kept reasonably free from surface accumulations of liquid hydrocarbons by use of approved skimmer pits, settling tanks, or other suitable equipment.

5. Be located away from the established drainage patterns in the area and be constructed so as to prevent the entrance of surface water.

VI TEMPORARY USE OF SURFACE PITS

Unlined surface pits may be used for handling or storage of fluids used in drilling, redrilling, reworking, deepening, or plugging of a well provided that such facilities are promptly and properly emptied and restored upon completion of the operations. Mud or other fluids contained in such pits shall not be disposed of by cutting the pit walls without the prior authorization of the District Engineer. Until finally restored, unattended pits must be fenced to prevent access by livestock and wildlife. Unless otherwise specified by the District Engineer, unlined pits may be used for well evaluation purposes for a period of 30 days.

Unlined pits may also be retained as temporary containment pits for use only in an emergency provided such pits have been approved by the District Engineer. Any emergency use of such pits shall be reported to the District Engineer as soon as possible and the pit shall be emptied and the liquids disposed of in an approved manner within 48 hours following its use, unless such time is extended by the District Engineer.

VII DISPOSAL FACILITIES FOR NEW WELLS

With the approval of the District Engineer, produced water from wells completed after the issuance date of this Notice may be temporarily disposed of into unlined pits for a period up to 90 days. During the period so authorized, an application for approval of the permanent disposal method, along with the required water analysis and other information, must be submitted to the District Engineer. Failure to timely file an application within the time allowed will be considered an incident of noncompliance and will be grounds for issuing a shut-in order until the application is submitted. With the approval of the District Engineer, the disposal method

may be continued pending his final determination. Once the District Engineer has determined the proper method of disposal, the lessee or operator will have until October 1, 1977, or 60 days following receipt of the District Engineer's determination, whichever is the longer, in which to make any changes necessary to bring the disposal method into compliance. However, if the disposal method then employed is endangering the fresh water in the area or otherwise constitutes a hazard to the quality of the environment, the District Engineer will direct prompt compliance with the requirements of this Notice.

VIII UNAVOIDABLE DELAY

A single extension of time not to exceed three months (six months in arctic and subarctic areas) may be granted by the District Engineer where the lessee or operator conclusively shows by application that, despite the exercise of due care and diligence, he has been unable to timely comply with the requirements of the Notice provided that such delay will not adversely affect the environment.

IX REPORTS

All unauthorized discharges or spills from disposal facilities must be reported to the District Engineer in accordance with the provisions of NTL-3.

Beginning October 1, 1978, and thereafter on an annual basis, lessees and operators must submit a report for each facility which includes the total volume disposed of during the reporting period and a current water analysis which provides the same type of information required for approval of the original application. Provided, however, that:

1. Where disposal is approved pursuant to Section IV (4), no annual water analysis will be required.

2. Where disposal is approved pursuant to a NPDES permit, a copy of the required discharge monitoring report may be submitted in lieu of the above annual report.

3. Where a single application was approved for several leases and/or facilities, a composite annual report covering all such leases and facilities may be submitted.

X COMPLIANCE

Compliance with this Notice does not relieve a lessee or operator of the responsibility for complying with more stringent applicable Federal or State water quality laws and regulations, including those which are subsequently promulgated pursuant to the Safe Drinking Water Act (P.L. 92-523), or with other written orders of the Geological Survey.

JAN 1 1976
Date

C J Curtis
Area Oil and Gas Supervisor

APPROVED:

Russell G. Wayland
Russell G. Wayland
Chief, Conservation Division

APPENDIX A-2

WYOMING OIL AND GAS
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December 1, 1982

123. MULTIPLE ZONE COMPLETION shall mean one in which two or more separate zones, mechanically segregated one from the other, are produced simultaneously from the same well.

124. LEGAL SUBDIVISION shall mean any regularly surveyed government quarter-quarter section or lot of approximately 40 acres.

125. FRESH WATER AND POTABLE WATER are defined as water currently being used as a drinking water source or having a total dissolved solids (TDS) concentration of less than 10,000 milligrams per liter (mg/l) and which (1) can reasonably be expected to be used for domestic, agricultural, or livestock use or (2) is suitable for fish or aquatic life.

SECTION II. GENERAL RULES

201. EFFECTIVE SCOPE OF RULES AND REGULATIONS

All rules and regulations of a general nature herein promulgated to prevent waste and to conserve oil and gas in the State of Wyoming shall be effective throughout the State of Wyoming and be in force in all pools except as may be amended, modified, altered or enlarged generally or in specific individual pools by orders hereafter issued by the Commission.

202. DUTIES OF SUPERVISOR

In addition to the duties prescribed by law it shall also be the duty of the Supervisor to aid the Commission in the administration of the Wyoming Conservation Law and under the direction of the Commission aid in the enforcement of all the rules and regulations of the Commission relating to oil and gas.

203. GENERAL FUNCTIONS OF SUPERVISOR

The Supervisor and his authorized agents shall also have the right at all reasonable times to go upon and inspect any oil and gas properties and wells for the purpose of making any investigation or tests to ascertain whether the provisions of the Wyoming Conservation Law or these rules or any individual pool rules are being complied with and shall report any violation thereof to the Commission.

204. DESIGNATION OF AGENT OR OPERATOR (Form 6)

A Designation of Agent or Operator shall be submitted to the Supervisor prior to the commencement of operations. A Designation of Agent

333. OPEN PIT STORAGE OF OIL

The owner shall not, except during an emergency or except by special permission of the Supervisor, permit oil to be temporarily stored or retained in earthen reservoirs or in any receptacle in which there may be undue waste of oil.

334. REPORT FOR GASOLINE OR OTHER EXTRACTION PLANTS
(Form 9, Sheets 1 and 2)

All operators of gasoline or other extraction plants shall make monthly reports to the Commission on Form 9, Sheets 1 and 2. Such form shall contain all information required therein and shall be filed with the supervisor by the 20th of the succeeding month.

335. VACUUM PUMPS

The installation of vacuum pumps or other devices for the purpose of imposing a vacuum at the well head on any oil or gas well or any oil or gas bearing reservoir is permitted only upon order of the Commission, or upon approval of the Supervisor, obtained pursuant to an application therefore filed in accordance with the Rules of Practice and Procedure. The application shall set forth the names of all owners within one-half (½) mile of the affected well or wells and shall be accompanied by a plat showing the location of all wells on applicant's lease and all offset wells of interested parties which have been or may be capable of being completed in the same pool or pools.

336. UNDERGROUND DISPOSAL OF WATER

The underground disposal of fresh water or of salt water, brackish water, or other water unfit for domestic, livestock, irrigation, or other general uses, is permitted only upon order of the Commission or approval of the Supervisor, obtained pursuant to an application therefore filed in accordance with the Rules of Practice and Procedure, as amended herein. Orders authorizing disposal wells shall remain valid unless revoked by the Commission for just cause.

The applicant shall have the burden of demonstrating that the proposed disposal operation will not endanger fresh water sources. Disposal wells shall be cased and the casing cemented in such a manner that damage will not be caused to oil, gas or fresh water sources.

The application to dispose of salt water, brackish water, or other water unfit for domestic, livestock, irrigation, or other general uses shall include:

(a) A plat showing the location of the disposal well or wells, including abandoned and drilling wells and dry holes, and the names of all lease operators or owners and surface owners within one-half (½) mile from the proposed disposal well or wells.

(b) An affidavit showing that said lease operators or owners and surface owners within one-half (½) mile radius have been provided a copy of the application for disposal.

(c) The names, description, and depth of the formation into which water is to be injected, including a mechanical log of the proposed disposal well or wells if one is available.

(d) A description of the casing in the disposal well or wells, or the proposed casing program and the proposed method for testing casing before use of the disposal well or wells.

(e) A statement specifying the source of water to be injected.

(f) The estimated minimum and maximum amount of water to be injected daily.

(g) The average and maximum disposal pressure.

(h) Evidence and data to support a Commission finding that the proposed disposal well will not initiate fractures through the overlying strata or confining zone which could enable the injection fluid or formation fluid to enter the fresh water strata.

(i) Standard laboratory analysis of the (1) water to be disposed and (2) the water in the formation into which disposal is taking place. The method of water analysis is subject to review by the Commission or Supervisor.

(j) A reference to the Commission order exempting the aquifer that is to receive the fluid.

Mechanical integrity for disposal wells completed or for wells converted to disposal after the effective date of the UIC program in Wyoming must be established according to Rule 403. Mechanical integrity for all disposal wells must be established by the operator in one of the following ways:

(a) The operator may test the casing-tubing annulus above the packer at a pressure of 1000 psi or maximum authorized injection pressure, whichever is greater, providing no testing pressure shall be less than 300 psi, not less than once every five-year period. A retrievable bridge

plug will be utilized in casing to test tubingless completions. In the event a representative of the Commission is unable to witness the test, the operator is required to provide documentation of the test to the Commission.

(b) The operator may monitor the pressure in the casing-tubing annulus during actual injection. The monitored annulus pressure must be reported monthly on the Report of Subsurface Injections (Form 5) or a format approved by the Commission on the Operator's Monthly Report of Wells (Form 2).

(c) The operator may provide the Commission with cementing records and logging surveys run on the disposal well during the time limit of the five-year period of review. As provided in Rule 207, if normal testing, surveys, or monitoring schedules are inconclusive proof of mechanical reliability, the Commission shall require a cement bond or other appropriate log, or additional well test, be run.

New owners are obligated to carry out previously approved programs in the manner originally approved. Change of ownership must be filed in accordance with Rule 311.

Modification or variations of existing or pending disposal operations may be approved by the Supervisor under Rule 307 upon application containing sufficient detail for the Supervisor to evaluate the proposed modification. Permits for remedial work under this section are only valid for ninety (90) days but can be extended on request by filing a Sundry Notice (Form 4) with the Supervisor assuming there has been no change in geologic, regulatory, or environmental situations. No such variance shall be approved unless the applicant proves to the Supervisor or the Commission that the variance will not endanger fresh water.

The applicant shall provide for a quarter (¼) mile radius of investigation for mechanical conditions of all wells which have penetrated the disposal zone surrounding a proposed disposal well. Specifically known and documented geological features may limit the need to review all wells within the quarter (¼) mile radius.

The Commission shall publish notice of the disposal application fifteen (15) days before approval in (1) a newspaper of general circulation in Natrona County and (2) a newspaper of general circulation in the county in which the disposal well is located.

Disposal operations must commence within one year of the approval date of the disposal application or the approval shall be null and void.

337. MULTIPLE ZONE COMPLETION OR COMMINGLING IN ONE WELL BORE

STATE OF WYOMING
OIL AND GAS CONSERVATION COMMISSION
BOX 2640, CASPER, WY 82602

Corrected Report ☐

OPERATOR'S MONTHLY REPORT OF WELLS

FORM 2 - SEE INSTRUCTIONS ON REVERSE
(REV. 11-1-81)

Injection Substance (water, gas, air, LPG, etc.) _____

Source of Injection Substance _____ Formation Injection Into _____

Type of Project _____

Operator _____ Code _____ Address _____ Month _____ , 19 _____

FIELD NAME - RESERVOIR NAME (UNDERLINED) LEASE NAME OR LEASE NUMBER - UNIT NAME WELL NO. QQ SEC TWP RGE	WELL IDENTIFICATION NO.				CLASS	STATUS	PRODUCTION INFORMATION					SALES		INJECTION INFORMATION				
	CO	WELL	S/T	RES			OIL BBLS	API	WATER, BBLS	GAS, MCF	DAYS PROD	OIL BBLS	GAS, MCF	Total Injection for Period bbls, MCF, gals	DAYS Inj.	Cumulative Injection bbls., MCF., gals.	Pressure PSIG (surface) Casing	Tubing

CLASSIFICATION CODE:
O - Oil well
G - Gas well
C - Condensate well
I - Injection well
S - Source well
D - Disposal well

STATUS CODE:
FL - Flowing
PR - Pumping Rods
PS - Pumping, Submersible
PH - Pumping, hydraulic
GL - Gas Lift
SI - Shut-in
TA - Temporarily Abandoned
PA - Permanently Abandoned
AI - Active injector

I HEREBY CERTIFY THAT THIS REPORT IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

Signature _____

Title _____

1. Time and Place of Filing - One copy of this report (two copies for State of Wyoming leases) shall be filed with the State Oil and Gas Supervisor at Casper, Wyoming, on or before the last calendar day of the month succeeding the month covered by the report.

2. Volumes - Volumes of oil shall be reported in barrels. Do not use fractions of barrels in this report. Gas volumes shall be reported in MCF (thousand cubic feet) only at a pressure base of 14.73 psi and a temperature base of 60° F.

3. Order of the Report - This report shall be a report of one operator for one field on a lease basis. Wells in unitized areas may be reported alphabetically by reservoir and numerically by well. Signature and title of the person authorized to sign need only appear on the last page of the report, provided pages are numbered and attached.

4. Lease Totals - In addition to individual well volumes of oil, water, and gas, lease totals of oil, water, and gas are also required. Sales volumes of oil and gas and API gravity are to be reported on a lease basis only.

5. Reservior Names - Reservior names are to include the approved field name and productive formation, e.g. Patrick Draw - Almond, Quealy Dome - Tensleep. If the well is located in an area which has not been named by Field Names Advisory Committee, it should be referred to as "undesignated" - (formation).

6. Well Status - All wells, regardless of status, shall be included on this report. Plugged and abandoned wells need not be reported after a Subsequent Report of Abandonment has been approved by the Supervisor.

7. For "type of project," insert Secondary Recovery (whether Pilot or Full-scale project), Pressure Maintenance, Storage, or Disposal.

8. "Source" refers to source of injection fluid. Show each and every different source on this form. If more room is needed than covered by this copy of the form, use additional forms.

9. Under "Total Injections for Period," show bbls, MCF, or gals. as applicable after each volume injected. Same applies to column designated "Cumulative Inj." Report gas volumes in MCF measured at a pressure base of 14.73 psi and a temperature of 60° F. and all liquid volumes in Standard U.S. 42 gallon barrels.

Form 5
November 1982

STATE OF WYOMING
OIL AND GAS CONSERVATION COMMISSION

WELL INTEGRITY REPORT

Test Date _____

Water Disposal Well ☐ Enhanced Recovery Well ☐ Other ☐

API Well ID Number _____ UIC Permit Number _____

Company _____

Representative _____

Rep's Phone & Address _____

Field/Unit _____ Well Name/Number _____

Location _____¼ _____¼ Section _____ Township _____ Range _____ County _____

Present at Completion: _____ Yes _____ No

Casing Tested in My Presence: _____ Yes ____ No Pressure _____PSI _____ Minutes

Packer Tested in My Presence: _____ Yes ____ No Pressure _____Psi _____ Minutes

Surface - Prod. Csg. Annulus _____ PSI Prod. Csg.-Tubing Annulus _____ PSI

Disposed/Injected Water Sample Taken: ____Yes _____No (Attach water analysis when obtained)

This well seems to be completed in accordance with WOGCC Rules 336/401/403:

Yes _____ No _____. If No, write report.

Remarks:

I hereby certify that this report is true and complete to the best of my knowledge. (This report must be notarized if a WOGCC Inspector was not present as a witness)

Name of operator _____

_____
(Signature) (Title)

_____
(WOGCC Field Inspector)

total amount injected, and the injected pressures and casing-tubing annulus pressure during injection if the operator elects the monitoring test requirements of Rule 401 on a monthly basis. Computerized forms submitted in lieu of Form 2 must contain the same information as that required on Form 2 and must be approved for format by the Commission staff.

406. UIC VARIANCES

The Supervisor shall have the latitude to grant variances to the regulations for standard fresh water protection for good cause and to provide that unnecessary hardship not be imposed. No such variance shall be approved unless the applicant proves to the Supervisor, if no hearing is necessary, or to the Commission, if a hearing is necessary, that the variance will in no way endanger fresh water.

407. AQUIFER EXEMPTION

The Commission may, after due and legal notice and public hearing, exempt from the definition of fresh and potable water in Rule 125 by order an aquifer which contains fresh and potable water because of any of the following:

(a) it is mineral, hydrocarbon, or geothermal energy producing;

(b) it is situated at a depth or location which makes recovery of fresh and potable water economically or technologically impractical;

(c) it is so contaminated that it would be economically or technologically impractical to render the water fit for use as fresh and potable water;

(d) it is located over a mining area subject to subsidence or catastrophic collapse; or

(e) it has a total dissolved solids (TDS) of more than 5,000 and less than 10,000 miligrams per liter (mg/l) and is not reasonably expected to be used as fresh or potable water.

Interested parties wishing to have an aquifer exempted must submit to the Commission an application which includes sufficient data to justify the proposal. The Commission will provide thirty (30) day legal notice prior to a public hearing on the matter.

SECTION V. RULES OF PRACTICE AND PROCEDURE BEFORE THE WYOMING OIL AND GAS CONSERVATION COMMISSION

501. ADOPTION OF RULES

Form 3160-3
(November 1983)
(formerly 9-331C)

COPY FORWARDED TO CASPER

SUBMIT IN TRIPLICATE*
(Other instructions on reverse side)

APPENDIX E

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK

5. LEASE DESIGNATION AND SERIAL NO.: ~~W-53418~~ W-02077

6. IF INDIAN, ALLOTTEE OR TRIBE NAME:

7. UNIT AGREEMENT NAME:

8. FARM OR LEASE NAME: LBD/WDW

9. WELL NO.: 235

10. FIELD AND POOL, OR WILDCAT:

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA: Sec. 35-T28N-R114W

1a. TYPE OF WORK: DRILL [X] DEEPEN [ ] PLUG BACK [ ]

b. TYPE OF WELL: OIL WELL [ ] GAS WELL [ ] OTHER WDW SINGLE ZONE [ ] MULTIPLE ZONE [ ]

2. NAME OF OPERATOR: Exxon Corporation

3. ADDRESS OF OPERATOR: Box 1600 Midland, Texas 79702

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ROCK SPRINGS, WYOMING

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.*)
At surface: 550' FSL and 2150' FWL of Section (SE SW)
At proposed prod. zone

14. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE*: 8 miles NW from Calpet

12. COUNTY OR PARISH: Sublette

13. STATE: WY

15. DISTANCE FROM PROPOSED* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drlg. unit line, if any)	16. NO. OF ACRES IN LEASE	17. NO. OF ACRES ASSIGNED TO THIS WELL

18. DISTANCE FROM PROPOSED LOCATION* TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR, ON THIS LEASE, FT.	19. PROPOSED DEPTH	20. ROTARY OR CABLE TOOLS
	12,500	Rotary

21. ELEVATIONS (Show whether DF, RT, GR, etc.): 7772' GR

22. APPROX. DATE WORK WILL START*: July 1, 1985

23. PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	QUANTITY OF CEMENT
26"	20"	94	80	120 Ft^3
12 1/4"	9 5/8"	40	3400	1065 Ft^3
9 1/2"	7"	26, 29	12500	1395 Ft^3

This is to be a water disposal well, not involved in any field production and will be located in the Dry Piney Unit. We have met with the other working interest owners and have prepared a letter agreement.

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen or plug back, give data on present productive zone and proposed new productive zone. If proposal is to drill or deepen directionally, give pertinent data on subsurface locations and measured and true vertical depths. Give blowout preventer program, if any.

24.

SIGNED Edgar Rowell TITLE Unit Head DATE 4-26-85

(This space for Federal or State office use)

PERMIT NO. _____ APPROVAL DATE _____

APPROVED BY _____ TITLE Assistant District Manager Mineral Resources DATE _____

CONDITIONS OF APPROVAL, IF ANY:

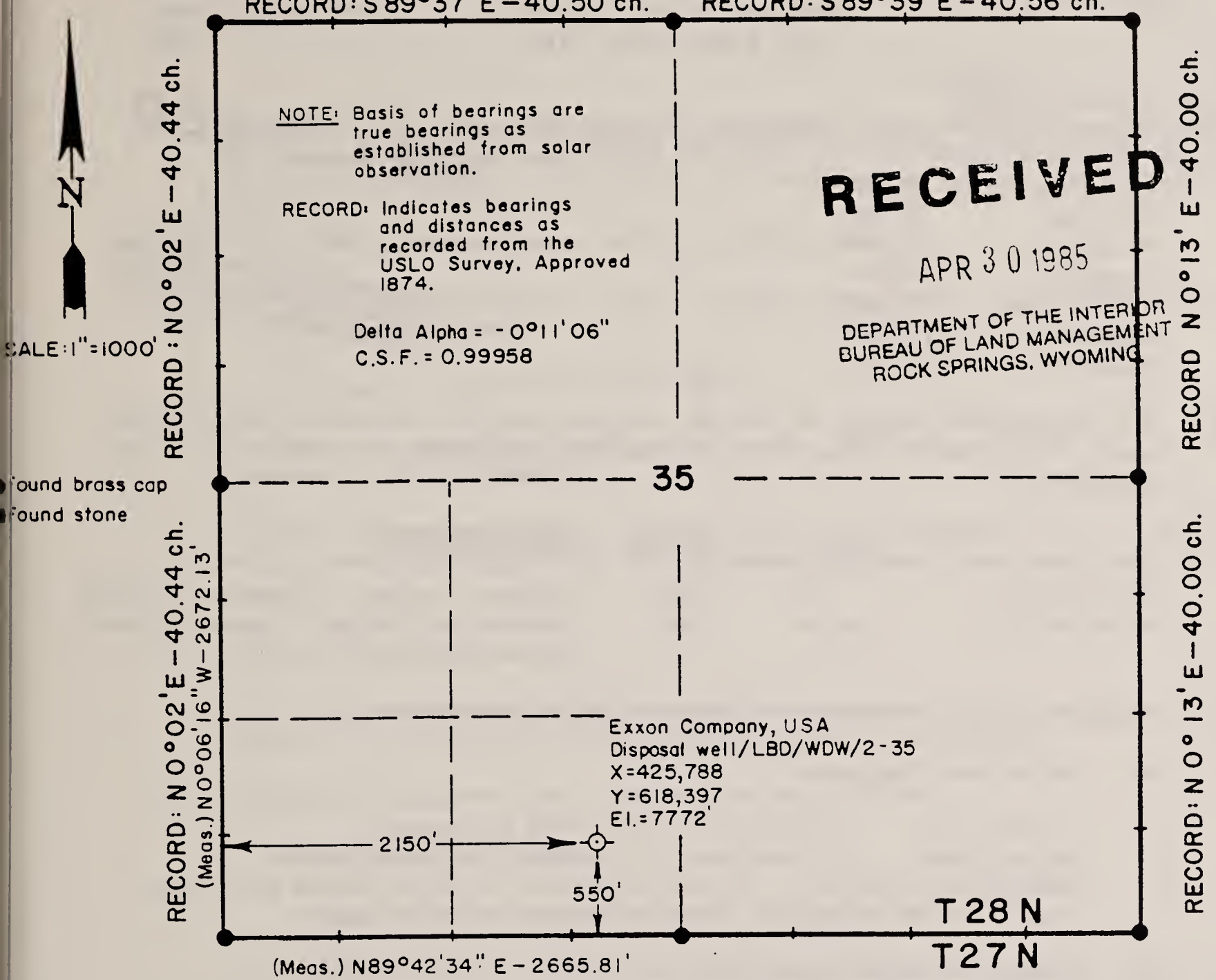
*See Instructions On Reverse Side

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

WILLIAM H. SMITH & ASSOCIATES P.C.
SURVEYING CONSULTANTS

POST OFFICE BOX 820
GREEN RIVER, WYOMING 82935

550 EAST 2 NORTH
PHONE 307-875-3638



I, John I. Dolinar of Green River, Wyoming hereby certify that in accordance with a request from Dan Bennett of Midland, Texas for LBDWDW 2-35 made a survey on the 7th day of March 1985 for location and elevation of the Disposal well/LBD/WDW/ 2-35 As shown on the above map, the wellsite is in the SE1/4 of the SW1/4 of Section 35, Township 28 North, Range 114 West of the 6th Principal Meridian, Sublette County, State of Wyoming Elevation is 7772 feet ungraded ground Datum USC & GS and USGS benchmark (1929 datum)

Reference Point Nothing set

Reference Point Nothing set

Reference Point Nothing set

Reference Point Nothing set

John I. Dolinar
WYOMING R.L.S. NO. 2608

Job No.: 85021.000
Date: 3/25/85
Drawn by: SLC

REGISTERED
WYOMING UTAH IDAHO
NEVADA NEW MEXICO ARIZONA
COLORADO

Exxon Corporation - LBD/WDW #235
SW 1/4 Section 35, T28N, R114W
Sublette County, Wyoming
BLM Eight Point Plan

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1. The estimated tops of important geologic markers:

Darby Thrust	3,200
Hilliard	3,300
Frontier	6,400
Gannett	8,800
Twin Creek	9,800
Nuggett	10,700
Ankareh	12,250

2. The estimated depths at which the top and the bottom of anticipated water, oil, gas or other mineral bearing formations are expected to be encountered:

	TOP	BOTTOM	HOW PROTECTED
Fresh Water	0	3300	Surface casing - Cement to surface
Frontier Gas	6400	7600	Production casing - Cement to 400' above Frontier

3. Minimum specifications for pressure control equipment:

A. Casinghead Equipment:

"A" Section: 9-5/8" LTC x 11" - 3000 psi sweet
Tubing Head: 11"-3000 psi x 7-1/16" - 5,000 psi - Sour
Tubing Head Adapter: 7-1/16"-5,000 psi x 3-1/8"-5,000 psi- Sour
Tree: 3-1/8" 5,000 psi Control Type Wellhead - Sour

B. Blowout Preventer Equipment:

TYPE	PRESSURE RATING	INSTALLED ON CASING
Type-C Diverter	-----	20"
Type-3A BOP Stack	3000 psi	9-5/8"

Additional preventers may be added and/or preventers with higher pressure ratings may be substituted, depending on equipment provided by drilling contractor. Diagrams of each preventer type are attached.

C. Testing:

Operational Testing: An operational test consisting of closing the annular preventer and pipe rams on the drill pipe and closing the blind rams on open hole will be performed on each round trip but not more than once each day.

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Pressure Testing: An initial pressure test will be performed after nippling up on a casing string but prior to drilling out. Equipment will be tested to 300 psi and 100% of the pressure rating on installation.

Subsequent pressure tests will be conducted:

° Upon any change in rams or other component of the BOP stack and/or choke manifold.

° At least every thirty (30) days.

Subsequent pressure tests will be at 300 psi and 70% of the working pressure of the equipment.

Blowout Prevention Drills: A drilling crew proficiency test to perform the well shut-in procedure will be performed at least once each week with each crew.

D. BOP Control Unit:

Unit will be hydraulically operated and have one control station located at least 60' from wellbore and one located on the rig floor.

4. Auxilliary Equipment and Proposed Casing Program:

A. Auxilliary Equipment:

Kelly Cocks: Upper and lower installed on kelly.

Safety Valve: Full opening ball type valve to fit each type and size of drill pipe in use will be available on the rig floor in the open position at all times for use when the kelly is not connected to the drill string.

B. Casing:

String	Size/Weight/Grade/Conn.	Depth Interval
Conductor	20"/ 94#/H-40/STC	0- 80'
Surface	9-5/8"/40#/K-55/LTC	0- 3,400'
Production	7" /26#/L-80/BT	0- 1,000'
	7" /26#/L-80/LTC	100- 2,500'
	7" /26#/K-55/LTC	2500- 7,500'
	7" /26#/L-80/LTC	7500- 9,500'
	7" /29#/L-80/LTC	9500-12,950'

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ROCK SPRINGS, WYOMING

C. Cement

Casing	Depth	Cement Type	Approximate Cement Volume	Top of Cement (Gauge Hole)
20"	80'	Redi-Mix	120 FT^3	Surface
9-5/8"	3400'	Light Cement Class "H"	525 FT^3 540 FT^3	Surface
7"	TD	Light Cement Class "H"	660 ~~855~~ FT^3 240 ~~540~~ FT^3	~~6300~~' 6000'

Calculated cement volume will be adequate to cover all hydrocarbon bearing formations.

D. Casing Test Procedures:

1. Surface Casing (9-5/8"): 2500 psi Test Pressure

2. Production Casing (7"): 5000 psi Test Pressure

5. Circulating Medium Characteristics:

A. Type and anticipated characteristics of circulating medium:

Depth Interval	Mud Type	Weight (ppg)	FV (Sec/Qt)	PV (cp)	YP (#/100sf)	WL (cc/30 min)	pH
0-3400'	Air/Mist/ FWM	8.4- 8.9	30-50	5-12	5-25	15-25	9.5-10.5
3400'-TD	Air/Mist/ FWM	8.4- 9.4	35-75	7-20	5-25	10-15	9.5-10.5

B. Quantities of Mud and Weighting Material:

Quantity: Not less than 200 BBLS of mud will be in the surface mud pits at all times.

Weighting Material: At least 200 SX of Barite will be stocked on location. Stock point for Barite and all other mud additives will be located within two hours away in Big Piney.

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C. Mud System Monitoring Equipment:

1. Pit Volume Totalizer: PVT will be used to monitor mud pits.

2. Trip Tank: Trip Tank will be used to keep hole full of fluid on trips and to monitor hole behavior on trips.

3. Mud Engineer: Engineer will check mud properties daily.

D. Air Mist Drilling Equipment:

° Ignitor - Pilot light will burn continuously at the end of the blooie line while air mist drilling.

° Blooie Line - Line will extend at least 150 feet from wellbore.

° Compressors - Compressors for air mist drilling will be located at least 125 feet from wellbore in a direction away from the blooie line.

° Mud Quantity - Sufficient mud or fresh water will be on location to fill the wellbore if well control problems develop while air mist drilling.

6. Anticipated type and amount of testing, logging, and coring:

Drill stem tests and coring are not planned.

Logging Program:

From 5500' to total depth: CNL-FDC-GR-Caliper
DIL-GR-SP

7. Expected bottom hole pressures, abnormal pressures and temperatures or any potential hazards:

A. Bottom hole pressure is expected to be less than ~~2500~~ 5000 psi at total depth.

B. No abnormal pressure or temperature hazards are expected.

8. Other Facets of Proposed Operation:

No special drilling operations are planned.

RHL/cdl
2/27/85

MAM 3-1 Dam 3-4

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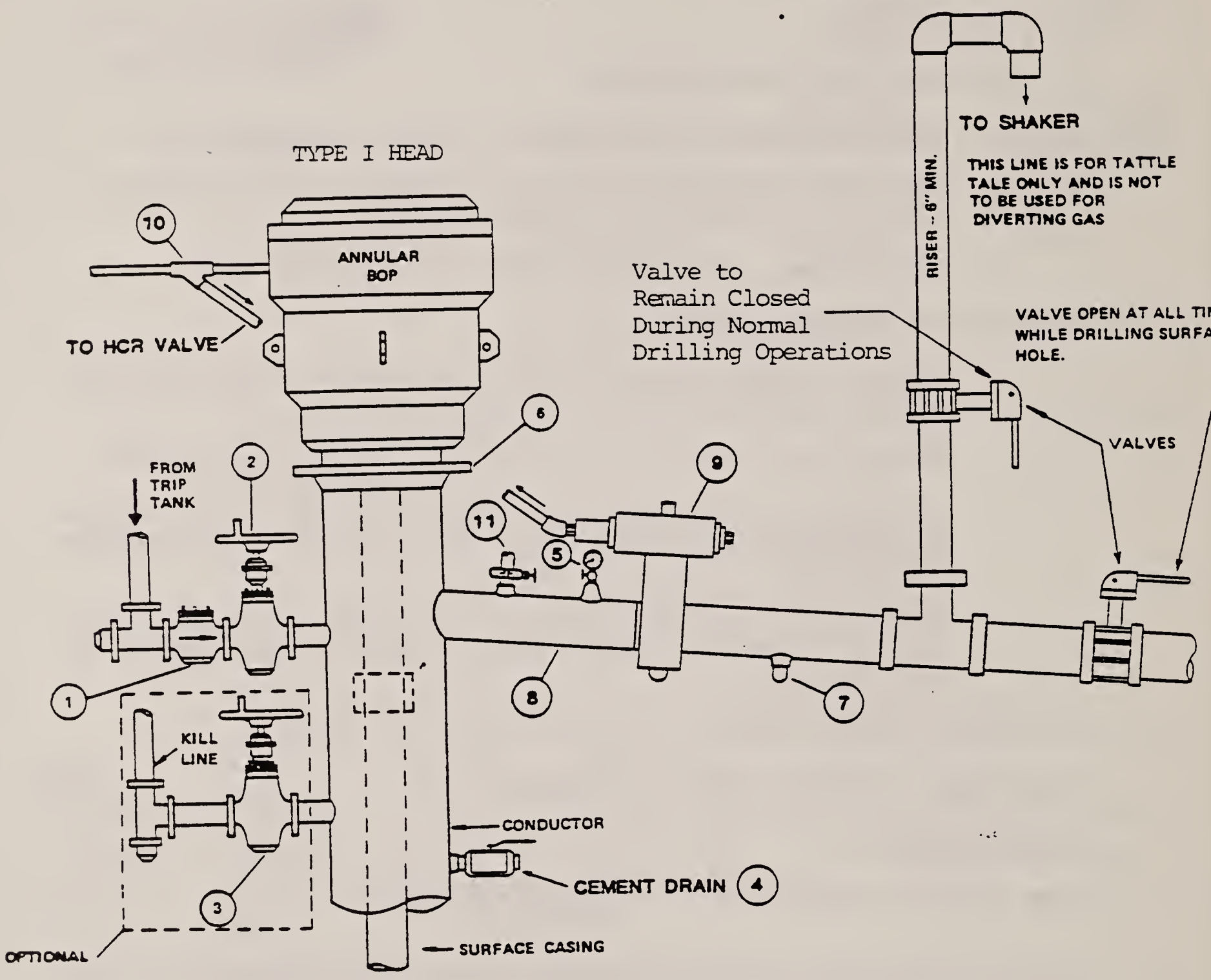
TYPE-C DIVERTER SYSTEM

COLD WEATHER AREAS



NOTE: FOR DIVERTER HEAD AND FLOWLINE SPECIFICATIONS, SEE PAGES II-60 AND II-61.

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BUREAU OF
ROCK

COMPONENT SPECIFICATIONS
Type-C Diverter System

1. BOP Companion flange — screwed or welded to conductor. As shown, a fabricated flanged spool with two diverter line outlets is recommended to save rig-up time for platform multiple well operations.
2. Flanged or screwed gate or plug valve — 3" minimum nominal dia. and 150 psi minimum working pressure.
3. Welded collar — 2" minimum nominal dia. — with bullplug. Cleanout connections.
4. 3" welded collar with bullplug. This connection is used to clean out cement.
5. 2" welded collar with tapped bullplug, valve, and pressure gauge.
6. Annular BOP companion flange — screwed or welded to conductor casing. Note: A flanged spool with a diverter line side outlet can be used to save rig-up time.
7. Welded collar — 2" minimum nominal dia. — with bullplug. Cleanout connections.
8. Diverter line minimum size 6" internal diameter.
9. Spring Return Power Actuator to open Butterfly Valve. 6" minimum Butterfly Valve will be kept closed during normal drilling operations. In the case of a well control problem, this valve should be opened simultaneously with the closing of the Annular Preventer.
10. Control Valve from sending unit to air pneumatic valve.
11. 2" line tied into mud line to clean cuttings out of diverter line.

NOTE:

A. Unless specified otherwise in the Bid Letter and/or Contract, the contractor will furnish and maintain all of the above equipment including annular BOP, bell nipple and trip tank line connections.

B. The diverter line valves and other diverter component equipment must be 150 psi minimum working pressure. (Offshore 300 psi minimum W.P.)

C. The diverter line valves must be designed to maintain full open or closed position.

D. Diverter lines must be securely anchored. Sleeve-type couplings should not be used for pipe joint connections and 45° or 90° ells must not be installed on the end of diverter lines to direct flow downward. These can cause the line to "kick-up" when large flow volumes are diverted.

TYPE-3A BOP STACK

THREE PREVENTERS
API (RSRA)

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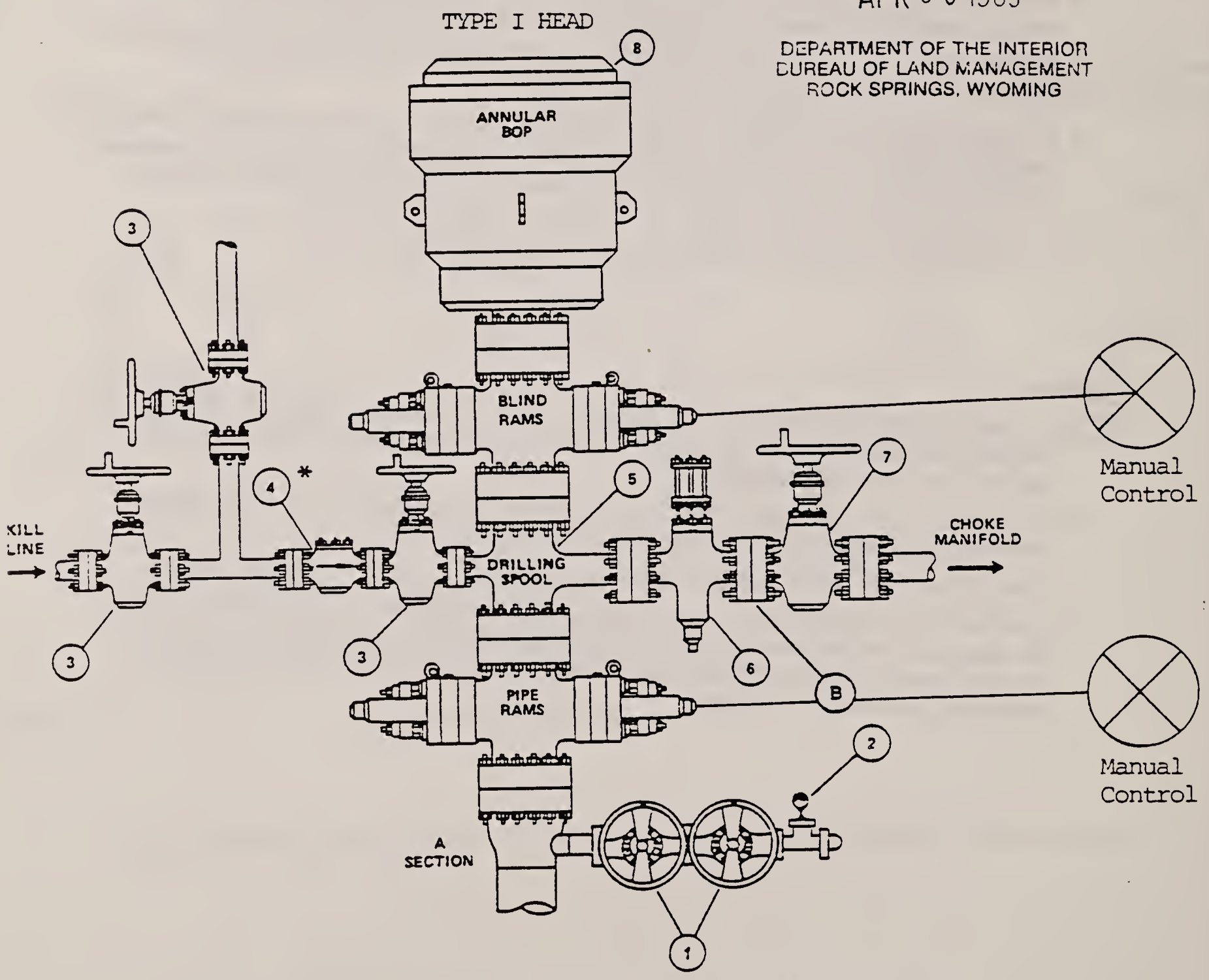
BUREAU OF LAND MANAGEMENT
ROCK SPRINGS, WYOMING



* IF AN HCV IS USED INSTEAD OF A CHECK VALVE IT MUST BE LOCATED NEXT TO THE SPOOL.

B – SEE ITEM B ON PAGE II–83.

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CASPER, WYOMING

COMPONENT SPECIFICATIONS
Type-3A BOP Stack

1. Screwed or flanged plug or gate valves — 2" minimum nominal dia. — same working pressure as "A" section.
2. Tee with tapped bullplug, needle valve, and pressure gauge.
3. Flanged plug or gate valve — 3" minimum nominal dia. — same working pressure as BOP stack.
4. Flanged spring-loaded or flapper type check valve — 3" minimum nominal dia. — same working pressure as BOP stack.
5. Drilling spool of sufficient height to allow stripping with 2 flanged side outlets — 3" choke and 2" kill line minimum nominal dia. (See Table II-4)
6. Flanged hydraulically controlled gate valve — 3" minimum nominal dia. — same working pressure as BOP stack.
7. Flanged plug or gate valve — 3" minimum nominal dia. — same working pressure as BOP stack.
8. Top of annular preventer must be equipped with an API flange ring gasket. All flange studs must be in place or holes filled in with screw type plugs.

NOTE:

a) Unless specified otherwise in the Bid Letter and/or Contract, the contractor will furnish and maintain all components shown above Exxon's wellhead.

b) The choke line between the drilling spool and choke manifold should not contain any bend or turn in the pipe body. Any bend or turn required should be made with a running tee with a blind flange or welded bullplug. All connections should be flanged or welded. All fabrications requiring welding must be done by a certified welder. Welds should be stress relieved when required.

c) Plug valves should be equivalent to the Howco Lo-Torc and gate valves equivalent to the Cameron Type 'F'.

FLOWLINE TYPE

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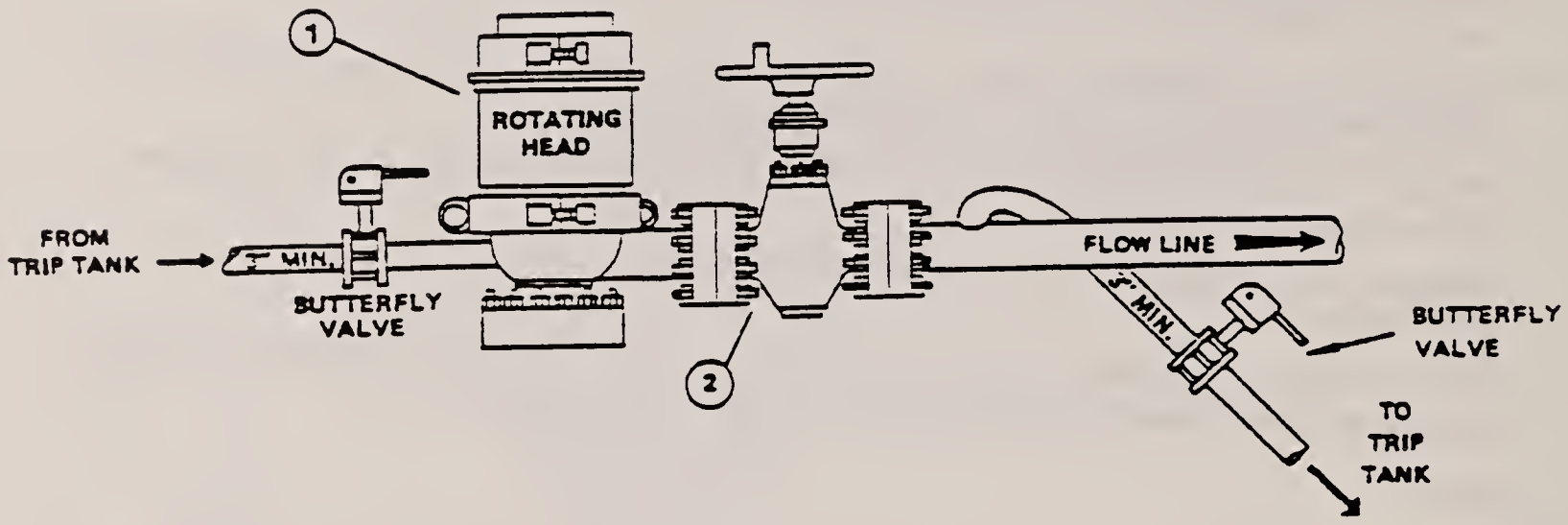
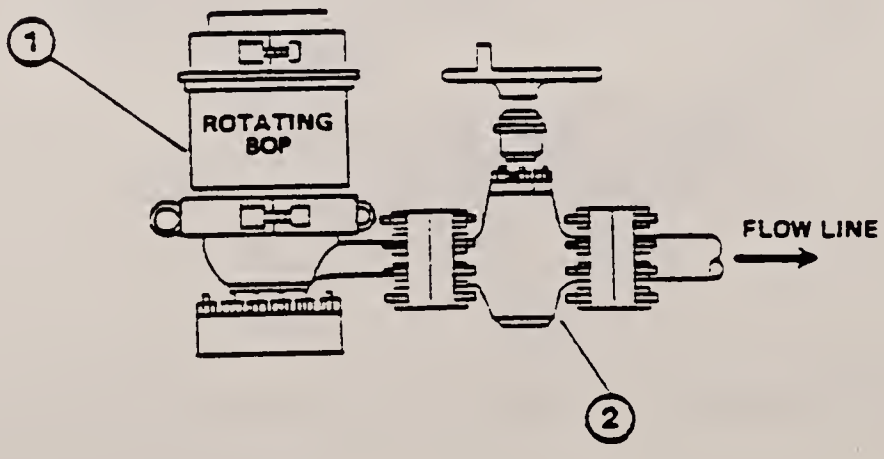
I. PUMP-FILL TRIP TANK AND ROTATING HEAD



II. GRAVITY-FILL TRIP TANK AND ROTATING HEAD



NOTES 1 AND 2 ON PAGE II-82.

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PUMP-FILL TRIP TANK AND ROTATING HEAD SPECIFICATIONS

1. Flanged rotating head.

2. Flanged plug or gate valve.

3. The I.D. of the bell nipple must not be less than the minimum I.D. of the B.O.P. stack.

FIGURE IV-1
EXAMPLE CLOSING SYSTEM SCHEMATIC
(3000 PSI WORKING PRESSURE)

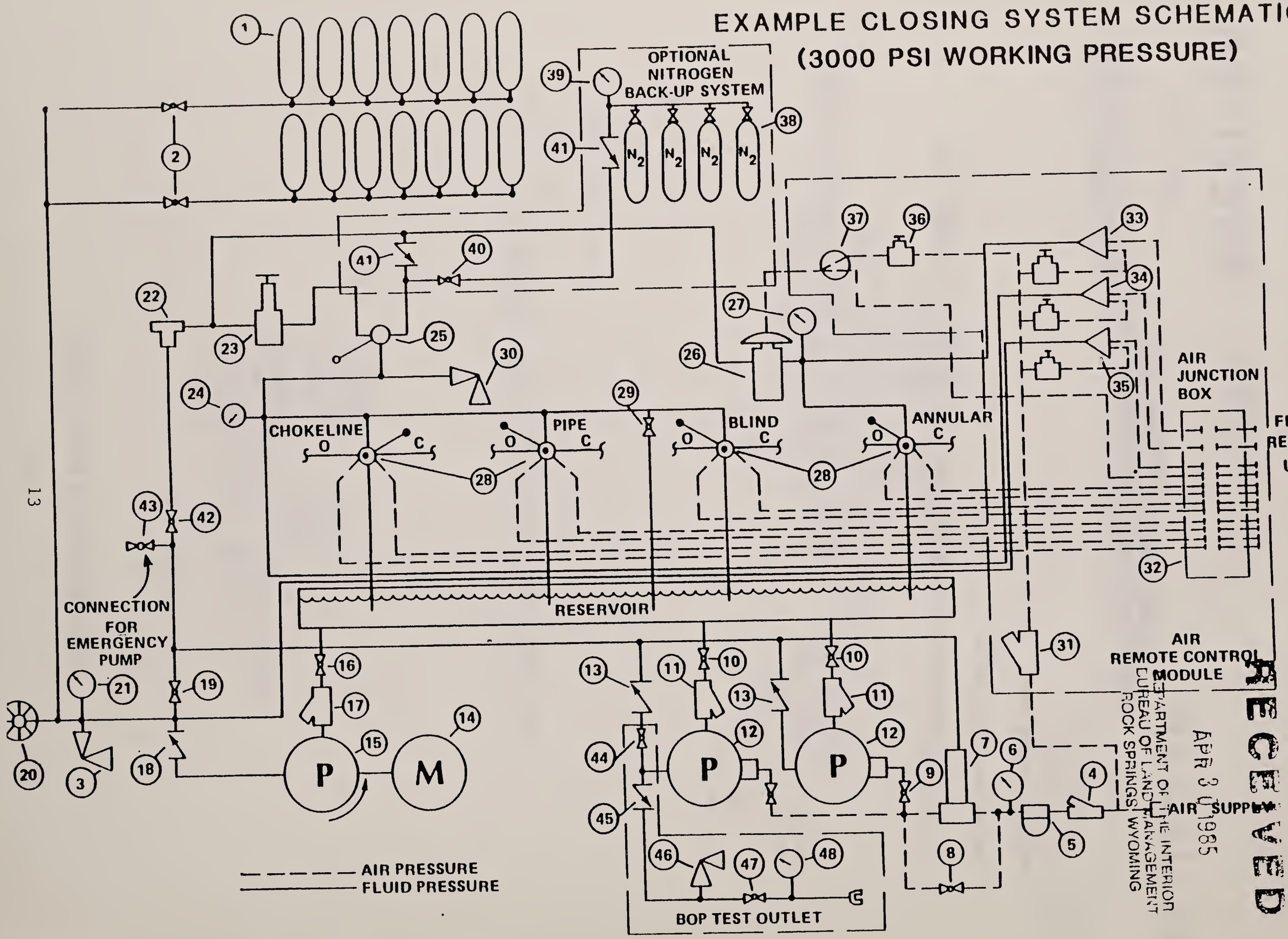

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FIGURE IV-2

COMPONENT DESCRIPTION

ACCUMULATOR BANK
1. ACCUMULATORS
2. ACCUMULATOR BANK ISOLATION VALVES
3. ACCUMULATOR RELIEF VALVE SET AT 3500 PSI

AIR PUMP
4. AIR STRAINER
5. AIR LUBRICATOR
6. AIR PRESSURE GAUGE,0-300 PSI
7. AIR PRESSURE SWITCH
8. PRESSURE SWITCH BYPASS VALVE
9. AIR PUMP SUPPLY VALVE
10. SUCTION VALVE
11. SUCTION STRAINER
12. AIR OPERATED HYDRAULIC PUMP
13. DISCHARGE CHECK VALVE

ELECTRIC PUMP
14. ELECTRIC MOTOR AND STARTER
15. DUPLEX OR TRIPLEX PUMP
16. SUCTION VALVE
17. SUCTION STRAINER
18. DISCHARGE CHECK VALVE
19. TRIPLEX PUMP ISOLATION VALVE
20. ELECTRIC PRESSURE SWITCH

MANIFOLD
21. ACCUMULATOR PRESSURE GAUGE, 0-6000 PSI
22. HIGH PRESSURE STRAINER
23. MANIFOLD REGULATOR (0-3000 PSI)
24. MANIFOLD PRESSURE GAUGE, 0-3000 PSI
25. MANIFOLD REGULATOR BYPASS VALVE
26. ANNULAR REGULATOR
27. ANNULAR PRESSURE GAUGE, 0-3000 PSI
28. 4-WAY CONTROL VALVE
29. MANIFOLD BLEEDER VALVE
30. MANIFOLD RELIEF VALVE SET AT 3600-3700 PSI

AIR REMOTE SYSTEM
31. AIR FILTER
32. AIR JUNCTION BOX
33. ANNULAR PRESSURE TRANSMITTER ASSY.
34. MANIFOLD PRESSURE TRANSMITTER ASSY.
35. ACCUMULATOR PRESSURE TRANSMITTER ASSY.
36. ANNULAR AIR PILOT REGULATOR
37. ANNULAR UNIT/REMOTE SELECTOR VALVE

NITROGEN BACK-UP
38. NITROGEN BOTTLE
39. NITROGEN PRESSURE GAUGE
40. NITROGEN BACK-UP SHUT-OFF VALVE
41. NITROGEN BACK-UP CHECK VALVE

EMERGENCY PUMP
42. EMERGENCY PUMP ISOLATION VALVE
43. EMERGENCY PUMP SHUT OFF VALVE

BOP TEST
44. BOP TEST ISOLATION VALVE
45. BOP TEST CHECK VALVE
46. BOP TEST RELIEF VALVE
47. BOP TEST SHUT-OFF VALVE
48. BOP TEST PRESSURE GAUGE

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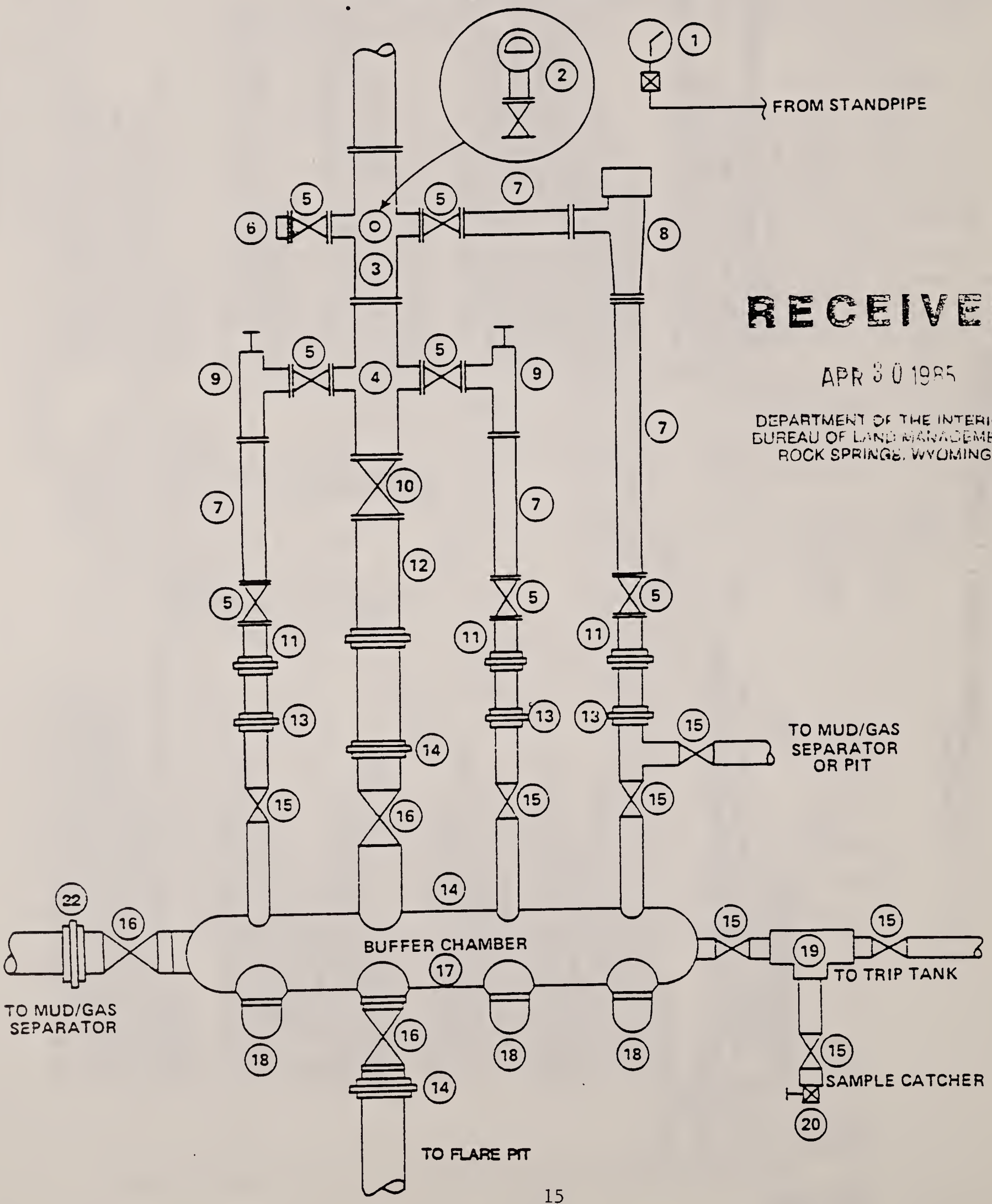
ROCK SPRINGS, WYOMING

FIGURE V-2

GUIDELINE FOR ARRANGEMENT OF THREE CHOKE MANIFOLD



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ROCK SPRINGS, WYOMING

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BUREAU OF LAND MANAGEMENT
HOT SPRINGS, WYOMING

COMPONENT SPECIFICATIONS
Figure V-2

1. Accurate pressure gauge (Martin Decker or equal) for measuring standpipe pressure. This gauge must be installed on a flexible Martin Decker or equal sealed line with transducer and have a working pressure rating equal to that of the BOP stack.
2. Diaphram type pressure gauge and gate or plug valve — 2" minimum nominal dia. — flanged to 5 way cross or to tee and valve installed between cross and first valve.
3. Flanged or studded cross — 3" x 3" x 2" x 2" x 2" minimum nominal dia.
4. Flanged or studded cross — 3" x 3" x 2" x 2" minimum nominal dia.
5. Flanged plug or gate valve — 2" minimum nominal dia. — valve to be same W.P. as choke.
6. Blind flange.
. Flanged spacer spool — 2" minimum nominal dia. and 18" minimum length.
8. Flanged hydraulic choke with maximum size orifice opening.
9. Flanged manually — adjustable choke equipped with tungsten carbide stems and seats with maximum orifice opening.
10. Flanged plug or gate valve — 3" minimum nominal dia. — valve to be same W.P. as chokes.
11. Companion flange with screwed nipple — 2" minimum nominal diameter.
12. Companion flange with screwed nipple — 3" minimum nominal diameter.
13. Screwed unions with nipple — 2" minimum nominal dia., flat face, hammer type.
14. Screwed unions with nipple — 4" minimum nominal dia., flat face, hammer type.
15. Screwed plug or gate valve — 2" minimum nominal diameter.
16. Screwed plug or gate valve — 4" minimum nominal diameter.
17. Buffer Chamber is optional — 8" minimum nominal dia. (Sch. 160 preferred).
18. Saddle welded to manifold with 3" screwed bullplug in place.
19. Screwed tee-2" minimum nominal diameter.
20. Screwed bullplug with screwed 1/2" needle valve for obtaining a flowing fluid sample.
21. Spare gauges.
22. **Screwed plug or gate valve — 6" minimum nominal diameter.**

NOTE:

A. The rated working pressure of the choke manifold equipment will be specified in the BID LETTER AND/OR DRILLING CONTRACT.
B. Unless specified otherwise in the BID LETTER AND/OR DRILLING CONTRACT, the Contractor will furnish and maintain all components shown except Item 1 which will be furnished by Exxon.
C. Contractor must furnish an acceptable mud/gas separator for each well. This separator must be equipped at all times with a 6" (minimum nominal dia.) gas flare line to exhaust gas to the flare line.
D. All components must comply with the attached *Specifications for Choke Manifold Piping, Fitting, and Connections.*
E. Plug valves should be equivalent to the Howco Lo-Torc and Gate Valves equivalent to the Cameron Type 'F'.
F. Crosses and valves may be substituted for the Buffer Chamber — Item 17.
G. Second hydraulic choke may be added, if specified, in place of one of the manually — adjustable chokes.

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DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
ROCK SPRINGS, WYOMING

SURFACE USE PLAN

Exxon Corporation
LBD-WDW Unit No. 2-35
550' FSL & 2150' FWL, Section 35, T28N R114W
Sublette County, Wyoming
Federal Lease Exxon W-53418

1. EXISTING ROADS - Area Map Exhibit "A" is a reproduction of the Cretaceous Mt. and the Hogsback quadrangle maps.

   A. Exhibit "A" shows the wellsite as staked.

   B. From Big Piney, Wyoming go south on Highway 189 for 2.9 miles. Turn right on County Road 134 and proceed for 17.5 miles. Turn right on the gravel road and travel west for 3.8 miles to a fork in the road. Proceed north 0.8 miles. Turn left on the gravel road and proceed northwest for approximately 800 feet. The proposed location is approximately 2500 feet to the west.

   C. Approximately 2600 feet of new road will be constructed to access the proposed location.

   D. Existing roads in the vicinity of this well are shown on Exhibit "A".

   E. The existing roads to the point of new construction are in good condition and will be maintained.

2. PLANNED ACCESS ROAD - Approximately 2600' of new road, shown on Exhibit "A", will be constructed to access the proposed location.

   A. The traveled way of the road will be approximately 12 feet (Sub-Base width 15 feet).

   B. The maximum anticipated grade will be 9%. This grade will be sustained for approximately 300 feet.

   C. Turnouts will be constructed at maximum intervals of 1000 feet and will be intervisible.

   D. Side ditches will be constructed at all cuts. Corrugated metal pipe and wing ditches will be installed to provide intermittent drainage and prevent erosion.

   E. Construction material will be obtained from roadway excavation and sidehill construction techniques.

   F. Surfacing material will be obtained from an existing gravel pit located in SWNE Section 26, T28N R114W.

   G. The proposed access road will be centerline staked.

3. LOCATION OF EXISTING WELLS WITHIN ONE MILE RADIUS

A. Water wells - none known.

B. Abandoned wells - Wexpro 28-DPU, NENW Section 2, T27N R114W

C. Temporarily abandoned wells - none known.

D. Disposal wells - none known.

E. Drilling wells - none.

F. Producing wells - MTM Fuel 11-DPU, (Dry Piney Unit) NWSE Section 34, T28N R114W
Belco 8-DPU, Center SE Section 35, T28N R114W
MTM Fuel 5-DPU, Center SE Section 2, T27N R114W
MTM Fuel 9-DPU, NESE Section 3, T27N R114W

G. Shut-in wells - none known.

H. Injection wells - none known.

I. Monitoring or observation wells for other resources - none known.

4. LOCATION OF EXISTING AND/OR PROPOSED FACILITIES CONTROLLED BY LEASEE/-OPERATOR

A. Production facilities and pipelines exist at each producing well listed above.

B. Since this is not a production well no production facilities will be required.

C. Rehabilitation will be done on any disturbed areas no longer needed for operations. This will consist of reshaping the existing surface to minimize erosion and seeding as specified by the BLM.

5. LOCATION AND TYPE OF WATER SUPPLY

A. A primary source of water will be obtained from Beaver Dam Creek Diversion Point (Permit No. 28413). Secondary source may be obtained from a diversion point located on Black Canyon Creek (Permit 28412).

B. Water would be hauled by truck over existing and proposed roads to the location from any of the proposed water sources.

6. SOURCE ON CONSTRUCTION MATERIALS

A. Gravel will be trucked to the site from an existing pit in SWNE Section 26, T28N R114W.

B. The existing pit is located on private land.

C. The aggregate will be used on the access road and pad.

D. The gravel will be hauled on existing roads and on the proposed access road to the well site. No additional haul roads will be required.

7. WASTE DISPOSAL

A. Drill cuttings will be disposed of in the reserve pit.

B. Drilling fluids will be allowed to temporarily evaporate in the reserve pit until the pit is dry enough for backfilling. If necessary to facilitate timely reclamation, excess fluid may be trucked from the pit by a licensed hauler to an approved disposal point.

C. Water produced during tests will be disposed of in the reserve pit. Oil produced during tests will be stored in test tanks until sold, at which time it will be hauled by truck from the site.

D. Sewage from trailer houses will be disposed of in a manner approved by the Wyoming Water Quality Division, Department of Environmental Quality, under Exxon Company, U.S.A. State Permit. This will consist of either a septic system with leach field, or a closed system with sewage periodically hauled to an approved disposal site.

E. Trash, waste paper, and garbage will be contained in a trash bin to prevent wind scattering during collection. This trash will be hauled from the site and disposed of at approved garbage collection facilities.

F. When the rig moves out all trash and debris left at the site will be contained to prevent wind scattering and hauled to a garbage disposal facility off of the site.

8. ANCILLARY FACILITIES - No camps, airstrips, etc., will be constructed.

9. WELLSITE LAYOUT

A. Exhibit "B" (Scale 1" = 50') shows the proposed wellsite layout.

B. This exhibit indicates the proposed location of mud and reserve pits, pipe racks, the trash bin and other major rig components, living facilities, spoil stockpile, parking areas and turn-in from access road.

C. The reserve pit will not be lined unless porous material is encountered, making the lining necessary for the lateral containment of fluids.

10. RESTORATION OF SURFACE

A. Revegetation and rehabilitation will begin as soon as practical after completion of operations. Oil on pits will be removed or disposed of in a manner approved by the appropriate agency. Upon rig move-out, the reserve pit will be fenced and so maintained until it is backfilled and reshaped.

B. During the first appropriate construction season after drilling operations, pits will be backfilled and contoured with material from the spoil pile. The portion of the drill pad not required for water injection operations will be contoured to combat erosion. Stockpiled spoil will be distributed to the extent needed to recontour these areas. The entire stockpiled topsoil will be distributed on the areas to be reclaimed.

C. The detailed "Erosion Control, Revegetation and Restoration Plan" will be submitted after the well has been completed.

11. OTHER INFORMATION

A. Topography is mountainous. Vegetation in the area consists of native grasses and sagebrush.

B. Surface ownership of the land at the proposed wellsite and on the access road is private.

C. There are no known archeological, historical, or cultural sites, and no occupied dwelling in the proximity.

12. OPERATOR'S REPRESENTATIVE - Field representative who can be contacted concerning compliance of this Surface Use Plan is:

A. L. Sossaman
P.O. Box 230
Midland TX 79702
Office phone: (915) 686-4352

13. CERTIFICATION - I hereby certify that I, or persons under my direct supervision, have inspected the proposed drillsite and access route; that I am familiar with the conditions which presently exist; that the statements made in this plan are, to the best of my knowledge, true and correct; and, that the work associated with the operations proposed herein will be performed by Exxon Corporation and its contractors and subcontractors in conformity with this plan and the terms and conditions under which it is approved. A copy of this plan will be posted at the wellsite during the drilling of the well for reference by all contractors and subcontractors.

4-26-85
Date

A. L. Sossaman
Drilling Operations Superintendent

For on-site inspection contact Melba Knipling at (915) 686-4406.

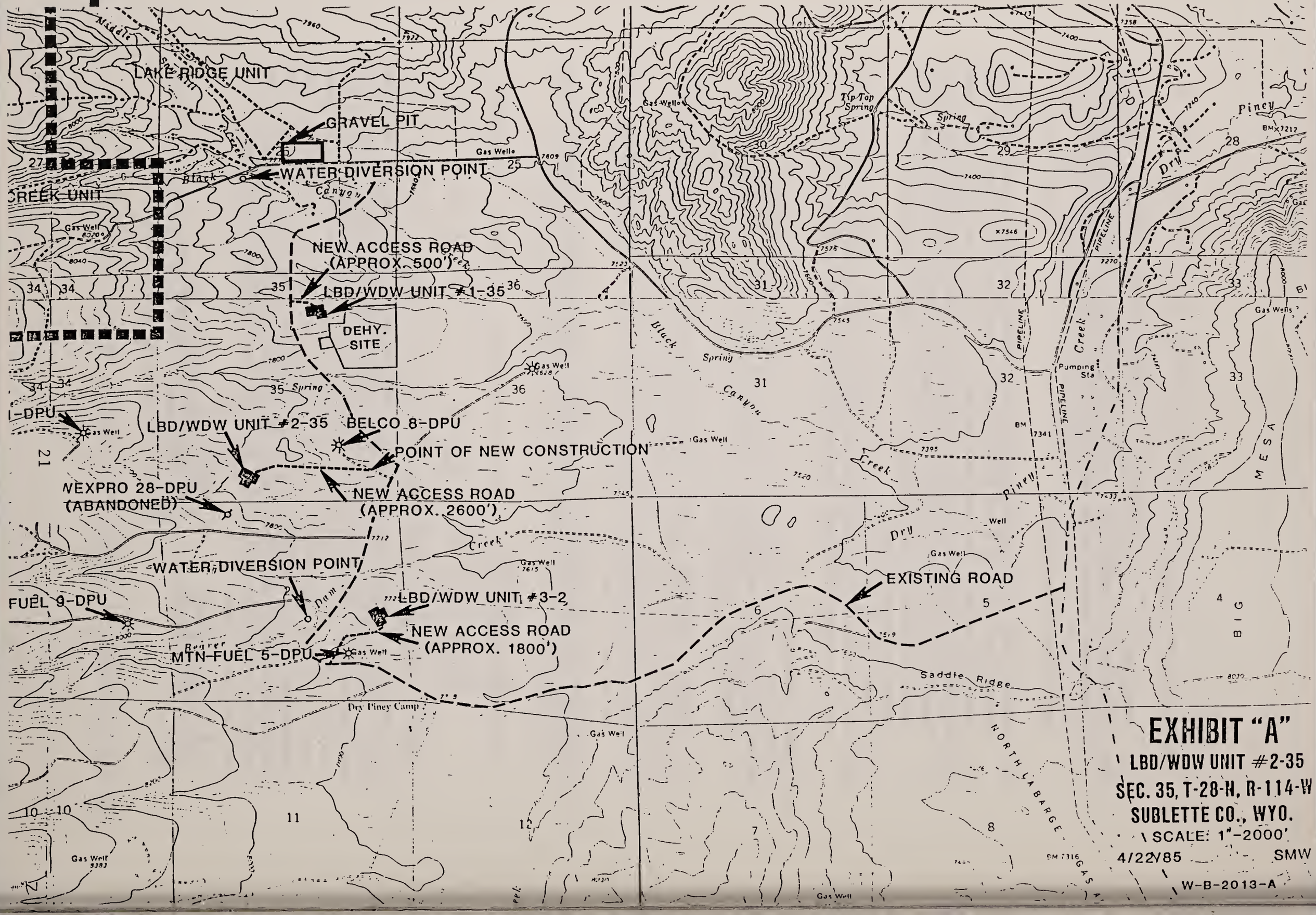


EXHIBIT "A"

LBD/WDW UNIT #2-35
SEC. 35, T-28-N, R-114-W
SUBLETTE CO., WYO.
SCALE: 1"-2000'
4/22/85 SMW
W-B-2013-A

APPENDIX C-1

ADDRESS LIST

Lease operators or owners within 1/2 mile of the proposed disposal wells:

Celsius/Wexpro Company
79 South State Street
Salt Lake City, Utah 84147
Attention: Mr. E. A. Farmer

Phillips Petroleum Company
8055 East Tufts Ave. Parkway
Denver, Colorado 80237
Attention: Mr. Robert Baker

Mobil Oil Corporation
P. O. Box 5444
Denver, Colorado 80217
Attention: Joint Interest Manager West

Belco Development Corporation
10000 Old Katy Road
Houston, Texas 77055
Attention: Mr. M. G. Papa

Surface owners within 1/2 mile of the three proposed disposal wells:

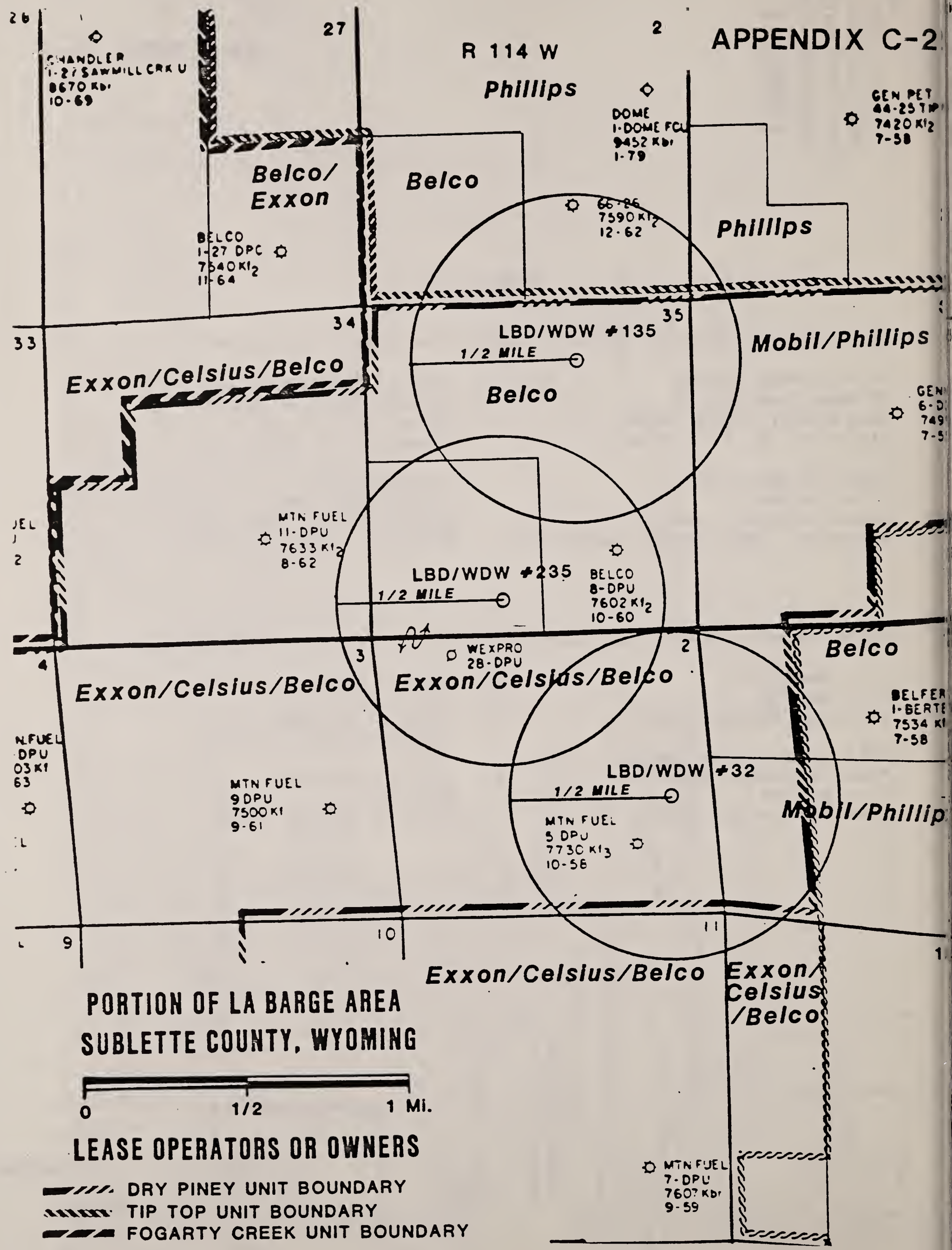
J. F. Ranch, Inc.
P. O. Box 280
Big Piney, Wyoming 83113

U.S.A., Dept. of the Interior - B.L.M.
Pinedale Resource Area
P. O. Box 768
Pinedale, Wyoming 82941

State of Wyoming
122 West 25th Street
Herschler Building
Cheyenne, Wyoming 82002

Lillian E. Harrower
Star Route
Kemmerer, Wyoming 83101

APPENDIX C-2



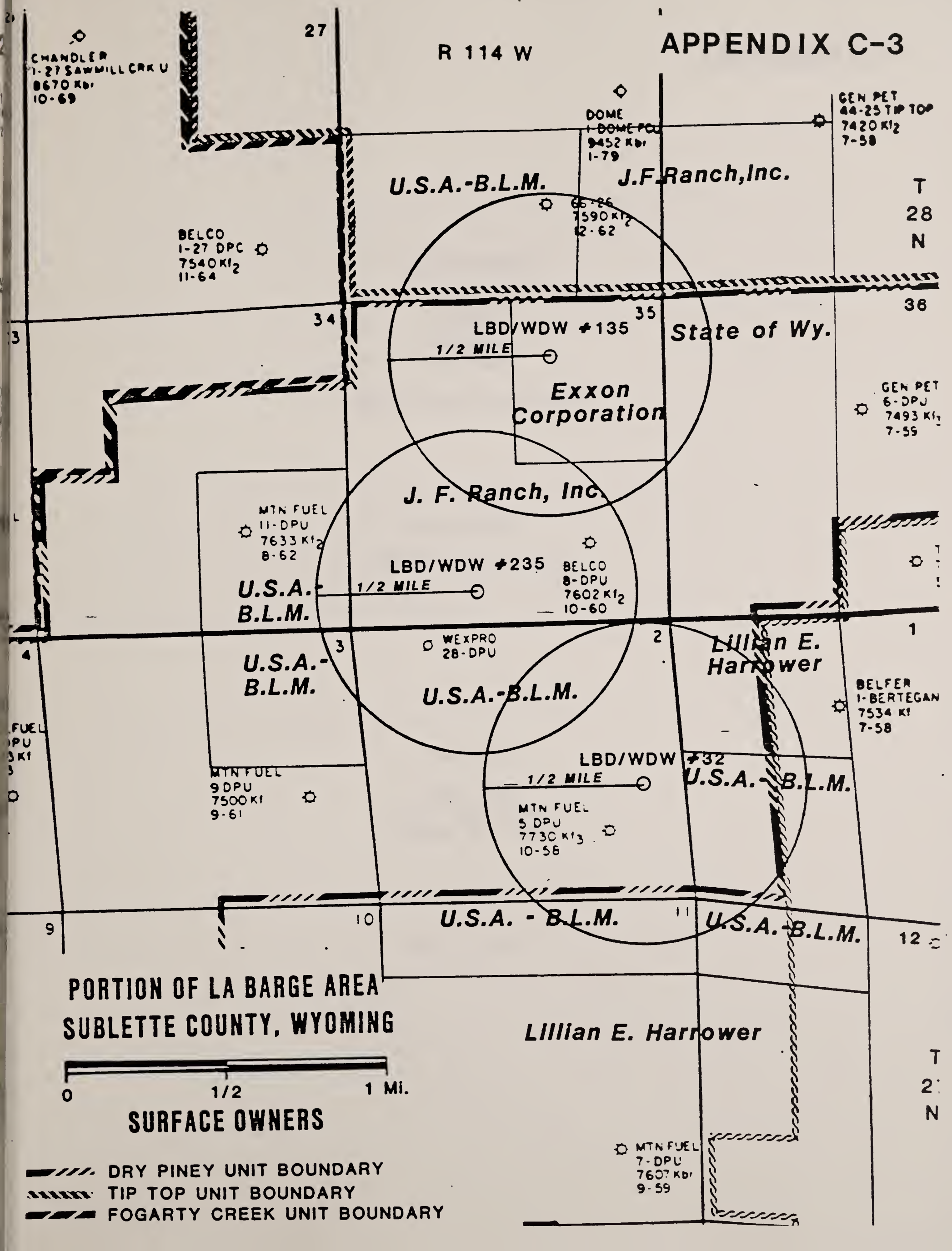
PORTION OF LA BARGE AREA
SUBLETTE COUNTY, WYOMING

0 1/2 1 Mi.

LEASE OPERATORS OR OWNERS

- DRY PINEY UNIT BOUNDARY
- TIP TOP UNIT BOUNDARY
- FOGARTY CREEK UNIT BOUNDARY

APPENDIX C-3



PORTION OF LA BARGE AREA
SUBLETTE COUNTY, WYOMING

0 1/2 1 Mi.

SURFACE OWNERS

- DRY PINEY UNIT BOUNDARY
- TIP TOP UNIT BOUNDARY
- FOGARTY CREEK UNIT BOUNDARY

APPENDIX D-1

ID TEAM REPORT

Hydrology
Soils
Vegetation
Aesthetics

Water Disposal Well #1-35

Prepared for

EXXON Company, U.S.A.

Prepared by

ECON INC.
2685 Airport Way
Helena, MT 59601

May 15, 1985

Hydrology

Background Information

Unit: Water Disposal Well #135 (WDW #135)
Date of ID visit: May 8, 1985
Location: NW 1/4, NE 1/4, S35, T28N, R114W
Drainage: Tributary to Black Canyon Creek
Outslope: Less than 2% to the east
Elevation: Natural ground, 7692 ft.
Disturbed Acres: Drilling; 3-4 acres
Operating; 100 feet by 100 feet
Topsoil: 6 inches

A. Environmental Concerns:
1. Sediment impacts to Black Canyon Tributary.
2. Shallow water table.
3. Snow Management.

B. Environmental Controls:
1. Outside diversion ditch and trap will be constructed.
2. Natural swale to the east will contain sediment in the event of runoff excursions from proposed sediment control structures.
3. Existing drainage channel may be impacted from surface water runoff. If the toe of the pad impacts the drainage, appropriate water runoff control structures will be installed.
4. Snow will be stored on the north side of the pad and parallel to the drainage.

Soils

Setting

Three soil types are recognized in the disturbance area of injection well pad and access road WDW #135, based on observations made in May, 1985. The first is like Soil Type 41, which is on toe slopes or convex ridges and is dominated by big sagebrush. The second is like Soil Type 19 and is in concave swales with a big sagebrush and bluegrass cover. The third is like Soil Type 34 and is on poorly drained concave swales and has a bluegrass cover. These were mapped as ERT order 3 map unit 92 (Jerry-Hoodle Complex 2-8%). Jerry soils correlate to ERRP Detailed Map Unit 19. Hoodle soils correlate to ERRP Detailed Map Unit 16. None of the soils have as many coarse fragments as the Hoodle soil. Nor are they as fine as Jerry soils. See Tables 1 and 2 for additional descriptions.

Interpretations

All three soils are rated with 12 inches of good-to-fair topsoil. Abundant coarse fragments in Soil Type 41 are limited to the upper three inches, and thus do not adversely affect a 12-inch salvage thickness. Soil Type 34 has a high water table that will make topsoil salvage difficult with standard salvage equipment. A white salt crust on the margins of the unit indicates a potentially high salt content in the surface horizons of Soil Type 34. Soil Type 19 has up to 18 inches of good quality topsoil in some places and has little or no coarse fragments. For more interpretations see Tables 3 and 4.

Recommendations

Salvage 12 inches of topsoil from Map Units 41A/210 and 19A/210. Avoid using materials from Map Unit 34A/150, due to a potential salt problem and a high water table.

Table 1. Setting of Soil Types in ERRP Detailed Map Units, WDW #135.

Soil Types	Parent Material		Topography			Vegetation	
			Dissection		Landform	Community	Indicator
	Type	Origin	Depth	Spacing	Position	Code	Species
19	sandstone and shale and quartzite	residuum and colluvium	shallow	wide	shoulders and south aspect slopes	210	big sagebrush
34	mixed rocks	alluvium	shallow	wide	bottom lands	150	willow-riparian
41	shale	residuum	shallow	wide	side slopes	111/210	grassland/ big sagebrush

Table 2. Characterization of Soil Types in ERRP Detailed Map Units, WDW #135.

				Properties of Soil Horizons							
				A Horizon				B or C Horizon			
Soil Type	Depth	Drainage Class	General Permeability	Thickness (in)	Gravel Content (%)	Textural Class*	pH	Thickness (in)	Gravel Content (%)	Textural Class*	pH
19	deep	well	mod-slow mod	14	20-25	sil	6.6-7.3	25	15-20	sicl	7.9-8.4
34	deep	poor	mod-rapid	12	0-10	l	7.8-8.4	48	30-50	l-ls	7.8-8.4
41	shallow	well	mod slow	9	20	l	6.4	9	20-25	cl	6.4

*Texture Code:

c = clay
cl = clay loam
f = fine
l = loam
ls = loamy sand
s = sand
sl = sandy loam
scl = sandy clay loam
si = silt
sic = silty clay
sicl = silty clay loam
sil = silty loam

Table 3. Slope Stability Ratings of ERRP Detailed Map Units, WDW #135.

Map Unit	Hydrologic Group	Soil Erodibility (K)	(BER)	Water Erosion Hazard	Sediment Delivery Hazard	Mass Failure Potential	Cutbank Sloughing Potential	Wind Erosion Potential
19	C	.24	.29	M	M	L	L-M	L
34	C	.32	.25	L	H	L	L-M	M
41	D	.24	.53	H	H	L	L	L

Table 4. Rehabilitation Potential Ratings of Soil Types in ERRP Detailed Map Units, WDW #135.

Soil Type	Compaction Potential	Rehabilitation Rating	Cover Soil Quality (0-6 in)	(6-12 in)	Reason for Poor Coversoil Rating	Maximum Available Good or Fair Coversoil (in)
19	M-H	F	F	F	—	60
34	L-M	F	G	G	—	12-60
41	M-H	F	G	G-F	—	18

Vegetation

A general survey of Injection Well #135 to identify and record vegetation within the disturbed boundary was conducted May 8, 1985. The following species, by lifeform, were observed during that predisturbance visit:

Big Sagebrush Type:

Grasses	Forbs	Shrubs
+ Poa sandbergii	- Antennaria species	+ Artemisia tridentata
+ Agropyron smithii	- Phlox hoodii	- Chrysothamnus nauseosus
0 Agropyron spicatum	- Eriogonum species	0 Leptodactylon pungens
0 Hesperochloa kingii	- Achillea millefolium	
0 Koeleria cristata	0 Erigeron compositus	
0 Elymus cinereus	0 Mertensia species	
0 Carex species	0 Arabis species	
	0 Potentilla species	
	0 Gilia species	
	0 Taraxacum officinale	

Moist Grass-Sedge Type:

+ Poa pratensis	0 Taraxacum officinale
+ Agropyron smithii	
- Poa sandbergii	
- Carex species 1 (possibly Nebraska sedge)	
0 Juncus species	
0 Carex species 2	
0 Elymus cinereus	

+ = abundant
- = occasional
0 = rare
Note - Ratings are based on the abundance of individual species, relative to one another.

The moist grass-sedge community is restricted to the northern quarter of the pad disturbance. This area is underlain by deep, fine-textured alluvial soils. The dominance of mesic grasses and sedges within this area indicates an increased degree of wetness below the surface. The grass and sedge species form a thick sod with very few, if any, forbs able to sustain competitive and viable populations. Light salt crusts were also observed on the soil surface, a factor which inhibits the presence of most upland species.

A big sagebrush community extends from the base of the drainage up onto a 10-15% north slope. Grass and forb densities decreased with the increase in slope. Chyrothamnus nauseosus was abundant at the ecotone between the two types.

Aesthetics

Existing Environment

LaBarge Project Injection Well #135 is located on private land. It lies within an area designated VRM Class III. The landscape condition (EIS overlay 18) is big sagebrush-grassland, bordered by aspen lowlands. Visibility (EIS overlay 17) is low.

The proposed site is located within a small drainage, immediately adjacent to the dehydration plant site and is bordered on two sides by the road into the site. Visibility will be high due to traffic entering and leaving the plant.

Alternatives

Relocation of the proposed site out of the drainage floor and closer to the sideslopes would cause more landform alteration and greater impact. Visual impact is minimized by site location on the relatively flat drainage bottom.

Permanent structures will be a noticeable, but subordinant, feature of the landscape. The buildings and associated facilities at the dehydration site dominate the surrounding landscape.

Recommended Mitigation

1. Painting of permanent structures in compliance with GWE recommendations.

APPENDIX D-2

ID TEAM REPORT

Hydrology
Soils
Vegetation
Aesthetics

Water Disposal Well #235

Prepared for

EXXON Company, U.S.A.

Prepared by

ECON INC
2685 Airport Way
Helena, MT 59601

May 14, 1985

Hydrology

Background Information

Unit: Water Disposal Well #235 (WDW #235)
Southwest of Dehydration Plant
Date of ID visit: May 8, 1985
Location: SE 1/4, SW 1/4, Section 35, T27N, R114W
Drainage: Tributry to Beaver Dam Creek
Outslope: Less than 5 % to the east
Elevation: Natural ground, 7772 ft.
Disturbed Acres: Drilling; 3-4 acres
Operating; 100 feet by 100 feet
Topsoil: 6 inches

A. Environmental Concerns:
1. Sediment impacts to Beaver Dam Creek.
2. Erosive Soils.
3. Sparse Vegetation.
4. High runoff potential.

B. Environmental Controls:
1. Outside diversion ditch and trap will be constructed.
2. All sediment controls structures will be designed to convey flow velocities equal to or less than 2.5 feet per second.
3. Sediment control structures will be located out of small drainage channels and all sediment traps will be designed and constructed to minimize downstream erosion impacts.

Soils

Setting

Two major Soil Types (01 and 45) are recognized in the injection well pad disturbance area, based on May, 1985 field observations. Both are on gently sloping ground that has been significantly eroded and dissected. Widely scattered low sage is on ridges and terraces of the north side and stunted big sage is on stream terraces in the southern portion. These were mapped as ERT Order 3 Map Unit 70 (Silas-Cryaquolls Complex, 2-8%). Drainage of soils at the well pad are not poorly drained like Cryaquolls. Organic matter accumulation is not as great as Silas soils.

Soils of the broad, gently-sloping ridge in the middle of the pad are a complex of soils like Soil Type 45 and Soil Type 01. The terrace positions are more like Soil Type 01. Less sand is in soils of the study area than in Soil Type 45. For more description see Tables 1 and 2.

Interpretations

Twelve inches of soil can be salvaged from Map Unit 45-01A/200. Below that, lime and sand content are too high to be suitable for topsoil. Map Units 01A/200 and 01A/210, on the terraces of the north and south borders, have 6 inches topsoil available for salvage. Clay content below that is too high for topsoil salvage. Soil erosion potential is higher than rated for Soil Types 01 and 45. For more interpretations see Tables 3 and 4.

Recommendations

Salvage 12 inches from the central ridge area, where soils of Map Unit 4501A/200 have sands that can improve the condition of the other soils which are rich in clays. Higher than standard mulch rates are recommended, to reduce the erodibility of these soils and to increase infiltration rates. Fertility should also be checked in the topsoil stockpile before respreading.

Table 1. Setting of Soil Types in ERRP Detailed Map Units, WDW #235.

Soil Types	Parent Material		Topography			Vegetation	
			Dissection		Landform	Community	Indicator
	Type	Origin	Depth	Spacing	Position	Code	Species
01	mixed rock	alluvium	deep	mod. wide	foothill ridges	210	big sagebrush
45	sandstone	alluvium and eolian	shallow-mod. deep	mod. wide	floodplain	111	grassland

Table 2. Characterization of Soil Types in ERRP Detailed Map Units, WDW #235.

Soil Type	Depth	Drainage Class	General Permeability	Properties of Soil Horizons							
				A Horizon				B or C Horizon			
				Thickness (in)	Gravel Content (%)	Textural Class*	pH	Thickness (in)	Gravel Content (%)	Textural Class*	pH
01	deep	well	moderate	3	15	fsl	7.4-7.8	12	25	sc	7.4-9.0
45	deep	well	rapid	3	—	ls	8.2	57	—	s	8.6

*Texture Code:

c = clay
cl = clay loam
f = fine
fsl = fine sandy loam
l = loam
ls = loamy sand
s = sand
sl = sandy loam
scl = sandy clay loam
si = silt
sic = silty clay
sicl = silty clay loam
sil = silty loam

Table 3. Slope Stability Ratings of ERRP Detailed Map Units, WDW #235.

Map Unit	Hydrologic Group	Soil Erodibility (K)	Soil Erodibility (BER)	Water Erosion Hazard	Sediment Delivery Hazard	Mass Failure Potential	Cutbank Sloughing Potential	Wind Erosion Potential
01	B	.24	.15	L	M	L	L	M
45	A	.18	.12	L	H	L	M	H

Table 4. Rehabilitation Potential Ratings of Soil Types in ERRP Detailed Map Units, WDW #235.

Soil Type	Compaction Potential	Rehabilitation Rating	Cover Soil Quality (0-6 in)	Cover Soil Quality (6-12 in)	Reason for Poor Coversoil Rating	Maximum Available Good or Fair Coversoil (in)
01	M	G	G	P	pH 9.0, sandy clay texture	3
45	L	P	P	P	loamy sand to sand texture	0

Vegetation

A general survey of Injection Well #235 to identify and record vegetation within the well pad boundary was conducted May 8, 1985. The following species, by lifeform, were observed during that predisturbance visit:

Low Sagebrush Type:

Grasses	Forbs	Shrubs
+ Poa sandbergii	+ Phlox species	+ Artemisia arbuscula
+ Agropyron smithii	+ Phlox hoodii	- Artemisia tridentata
0 Agropyron spicatum	+ Astragalus species	0 Ceratoides lanata
0 Festuca idahoensis	- Lomatium species	0 Chrysothamnus viscidiflorus
	- Arenaria species	
	- Eriogonum species	
	0 Taraxacum officinale	

+ = abundant
- = occasional
0 = rare
Note - Ratings are based on the abundance of individual species, relative to one another.

This site had very low densities of grasses and forbs. Production was estimated to be between 200 and 300 lbs/ac of grazable forage. The erodibility of the fine-textured soils and exposed position of the small knob, where the pad will be constructed, has limited the competitiveness of most plant species. Most precipitation runs off the surface before it can be absorbed. That which is absorbed is held tightly by the clay particles. The lack of organic matter and deficient nutrient levels inhibit sustained plant growth. In order to increase organic matter content, a heavy straw mulch, crimped into the replaced topsoil, is recommended for final reclamation. Fertilizer will also need to be applied.

Aesthetics

Existing Environment

LaBarge Project Injection Well #235 is located on private land. It lies within an area designated VRM Class III. The landscape condition (EIS overlay 18) is sagebrush grassland bordered by aspen lowlands. Visibility (EIS overlay 17) is low.

The proposed site is located within a small drainage, approximately one quarter of a mile from the dehydration plant site. It is well-screened by topography from surrounding viewpoints and is only visible from a gravel road approximately one eighth of a mile away. Potential viewers are not oriented toward the proposed site and views will be of very short duration.

Alternative Sites

Relocation of the proposed site within the immediate drainage bottom would result in a comparable degree of visual impact. Within this area slope and vegetative cover are relatively uniform.

Alternative sites out of the drainage bottom have potential for greater landform alteration, higher visibility, and increased visual impact.

Recommended Mitigation

1) Painting of permanent structures in compliance with GWE recommendations.

APPENDIX D-3

ID TEAM REPORT

Hydrology
Soils
Vegetation
Aesthetics

Water Disposal Well #32

Prepared for

EXXON Company, U.S.A.

Prepared by

ECON INC.
2685 Airport Way
Helena, MT 59601

May 15, 1985

Hydrology

Background Information

Unit: Water Disposal Well #32 (WDW #32)
South of Dehydration Plant
Date of ID visit: May 8, 1985
Location: NE 1/4, SE 1/4, Section 2, T27N, R114W
Drainage: Tributary to Beaver Dam Creek
Outslope: Less than 4% to the east
Elevation: Natural ground, 7765 ft.
Disturbed Acres: Drilling; 3-4 acres
Operating; 100 feet by 100 feet
Topsoil: 6 inches

A. Environmental Concerns:
1. Sediment impacts to Beaver Dam Creek.
2. Erosive Soils.
3. Sparse Vegetation.
4. High runoff potential.

B. Environmental Controls:
1. Outside diversion ditch and trap will be constructed.
2. All sediment control structures will be designed to convey flow velocities equal to or less than 2.5 feet per second.
3. Sediment control structures will be located out of small drainage channels and all sediment traps will be designed and constructed to minimize downstream erosion impacts.

Soils

Setting

Two soil types are recognized in the disturbance area of injection well WDW #32 well pad, based on May, 1985 field observations. Both are on gently-sloping, north-facing slopes with varying degrees of sagebrush cover. The area was mapped as ERT Order 3 map unit 75 (Heath Variant-Jerry-Brownsto Complex, 5-15%). These correlate to Detailed Soil Types 14, 19 and 05 respectively. Soils observed in the field are more like 02 on the south end of the pad and like 01 on the north end of the pad. See Tables 1 and 2 for more description.

Interpretations

Twelve inches of topsoil are good-to-fair quality in the southern portion of the well pad (Map Unit 02A/200). Only 6 inches of good-to-fair quality topsoil is available for salvage on the northern portion of the well pad, due to high clay content in the subsurface horizon.

Silt loam to loam soil textures are very susceptible to erosion in this setting. Wind erosion potential is moderately high to high.

Recommendations

Remove 12 inches of topsoil in the southern portion and 6 inches in the northern portion of the well pad. Extra mulch is recommended on the topsoil salvage pile and on the final regraded surface.

Table 1. Setting of Soil Types in ERRP Detailed Map Units, WDW #32.

Soil Types	Parent Material		Topography			Vegetation	
	Type	Origin	Dissection Depth	Dissection Spacing	Landform Position	Community Code	Indicator Species
01	mixed rock	alluvium	shallow-none	wide-none	foothill ridges	210	big sagebrush
02	sandstone and shale	alluvium	shallow-none	wide-none	foothill ridges	200	low sagebrush

Table 2. Characterization of Soil Types in ERRP Detailed Map Units, WDW #32.

Soil Type	Depth	Drainage Class	General Permeability	Properties of Soil Horizons							
				A Horizon				B or C Horizon			
				Thickness (in)	Gravel Content (%)	Textural Class*	pH	Thickness (in)	Gravel Content (%)	Textural Class*	pH
01	deep	well	moderate	3	15	fsl	7.4-7.8	12	25	sc	7.4-9.0
02	deep	well	moderate	2	5	l	7.4-7.8	28	15	cl	7.4-8.4

*Texture Code:

c = clay	sl = sandy loam
cl = clay loam	scl = sandy clay loam
f = fine	si = silt
l = loam	sic = silty clay
ls = loamy sand	sicl = silty clay loam
s = sand	sil = silty loam

Table 3. Slope Stability Ratings of ERRP Detailed Map Units, WDW #32.

Map Unit	Hydrologic Group	Soil Erodibility (K)	Soil Erodibility (BER)	Water Erosion Hazard	Sediment Delivery Hazard	Mass Failure Potential	Cutbank Sloughing Potential	Wind Erosion Potential
01	B	.24	.15	L	M	L	L	M
02	B	.28	.29	M	M	L-M	L-M	M

Table 4. Rehabilitation Potential Ratings of Soil Types in ERRP Detailed Map Units, WDW #32.

Soil Type	Compaction Potential	Rehabilitation Rating	Cover Soil Quality (0-6 in)	Cover Soil Quality (6-12 in)	Reason for Poor Coversoil Rating	Maximum Available Good or Fair Coversoil (in)
01	M	G	G	P	pH 9.0, sandy clay texture	3
02	M	G	G	F	—	60

Vegetation

A general survey of Injection Well #32 to identify and record vegetation within the well pad boundary was conducted May 8, 1985. The following species, by lifeform, were observed during that predisturbance visit:

Low Sagebrush Type:

Grasses	Forbs	Shrubs
+ Poa sandbergii	+ Arenaria capillaris	+ Artemisia tridentata
+ Agropyron smithii	+ Phlox hoodii	- Chyrsothamnus nauseosus
- Hesperochloa kingii	+ Astragalus species	0 Artemisia arbuscula
- Festuca idahoensis	- Lomatium species	0 Leptodactylon pungens
0 Agropyron spicatum	- Eriogonum species	0 Purshia tridentata
	- Agoseris species	0 Taraxacum officinale
	0 Achillea millefolium	
	0 Crepis species	
	0 Cirsim species	
	0 Arabis species	

\+ = abundant
\- = occasional
0 = rare
Note - Ratings are based on the abundance of individual species, relative to one another.

This site falls within a big sagebrush-grassland vegetation type. Vegetative composition was irregular throughout the pad area. The understory was dominated by Arenaria capillaris throughout most of the site, being replaced by grasses near the northern quarter of the disturbance boundary. Overall, grass production was moderate, with no soil or topographic restrictions. Several unidentified weed species were observed in the general vicinity of the pad area, a likely result of past over-grazing by cattle. Reclamation potential is good.

Aesthetics

Existing Environment

LaBarge Project Injection Well #32 is located on BLM land within an area designated VRM Class III. The landscape condition (EIS overlay 18) is big sagebrush-grassland, bordering aspen lowlands. Visibility (EIS overlay 17) is low.

The proposed site is located on gently-sloping topography, approximately one mile south of the dehydration plant site. Visibility is unrestricted to the north and east, and the proposed site will be highly visible to potential viewers leaving the plant site and traveling south. A few trailers are located approximately one quarter of a mile south of the proposed wellsite. It is likely that construction-phase activities will be visible to them, but operation facilities will be screened by a small ridge.

Alternatives

No alternative sites were proposed or evaluated for this injection well. Any alternative in the immediate vicinity would have a comparable degree of visual impact.

Recommended Mitigation

1) Painting of permanent structures (well head) in compliance with GWE recommendations.
2) Measure V-7 from Record of Decision.

APPENDIX E

EVALUATING FORMATIONS TO BE USED FOR WASTE WATER INJECTION

GEOLOGIC FACTORS

1). Is the formation a good reservoir? Does it have sufficient porosity and permeability to be a good reservoir? What are the formations above and below the injection formation? The formation being injected into should have good "sealing" formations above and below so that the injected waste water remains isolated. The potential for local fracturing or the existence of faulting which could allow the escape of injectants must be considered.

2). What is the fracture gradient (parting pressure) of the formation into which the wastewater is being disposed, as well as that of the adjacent formations? It is essential that these fracture gradients be known in order to determine whether the formation above or below would fracture from the injection pressure. Fracturing the adjacent formation could lead to migration and contamination.

3). What is the anticipated formation pressure once injection begins? Increased pressure could affect nearby fields which produce from the same formation. Over pressuring the formation could cause future drilling hazards.

4). What are the chemical constituents of the waste water that could cause problems? For example, introducing hydrogen sulfide (H_2S) into a formation(s) where it does not normally occur could cause numerous problems if diffuses to wells in area (ie., corrosion of casing; unexpected production of H_2S; encountering H_2S during drilling when not expected). The severity of the problem would depend on the amount of H_2S introduced and the proximity to existing wells.

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